Tropical
Crops

WORLD CROPS

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The International Journal of Agriculture

VOLUME 9, No. 12 DECEMBER 1957

A Publication of The Leonard Hill Technical Group

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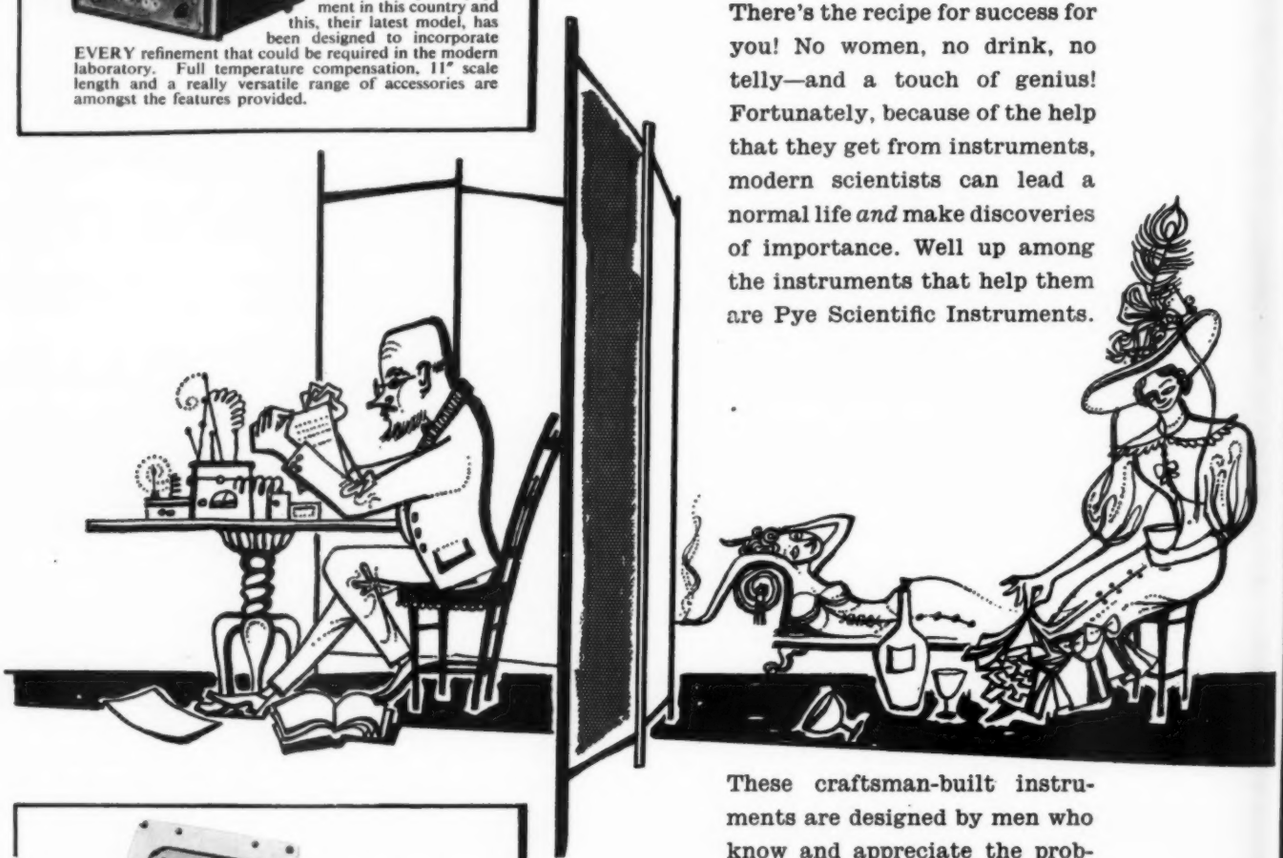

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shadow on sweetness

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Yet for years a shadow has lain across its sugar fields — caused mainly by the sugarcane borers *Chilotraea infuscatella* and *Scirpophaga nivella*. These voracious burrowing caterpillars, larvae of inconspicuous grey moths, swarm in the cane in plague proportions, for the local conditions—which provide cane at all stages of growth throughout the year—make life sweet for borers to feed, breed and multiply. But not for farmers, who frequently see whole areas of cane reduced to dry, useless stubble—and who live permanently with disaster staring them in the eye.

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Model 155

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TRADE-MARK TRADE-MARK

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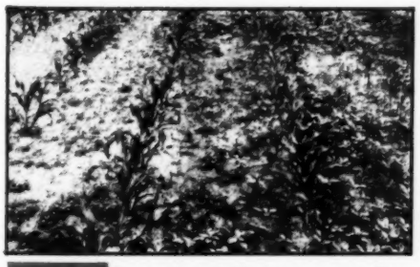
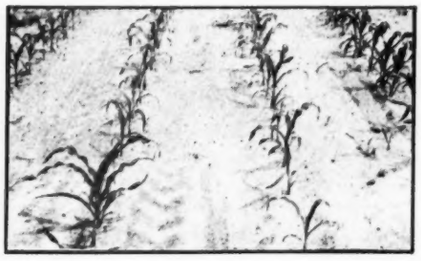


WITHOUT CRAG Brand SESONE sprayed on, this cornfield was robbed of nourishment by choking weeds.



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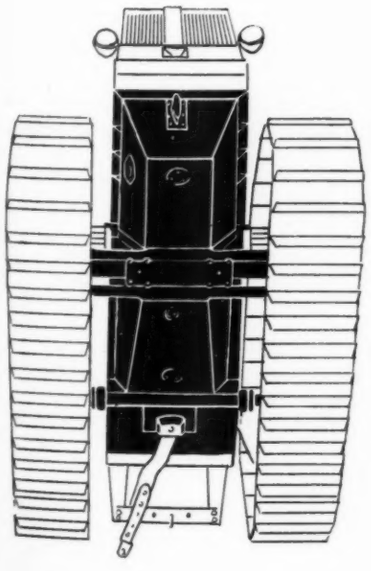

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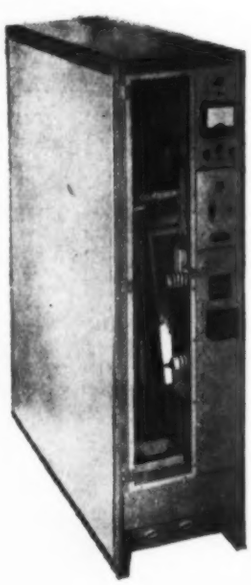

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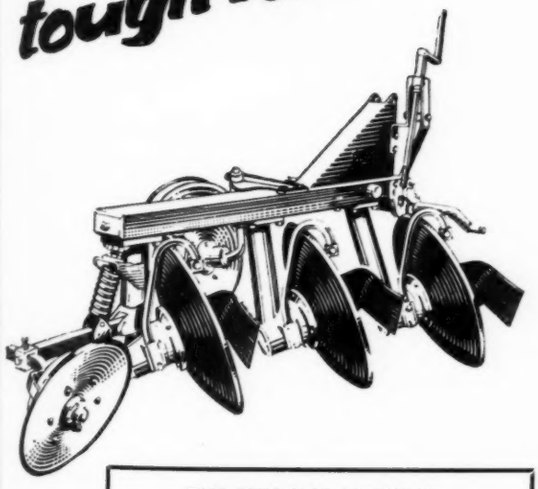
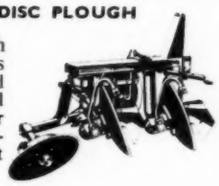
but not too tough for the



THE TWO-DISC PLOUGH

The two-disc plough is similar to its larger brother and has been developed for the smaller wheeled tractor, fitted with three-point linkage.



HUDSON
Three Disc Plough

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The discs themselves are made of toughened steel to withstand shocks and ensure long life. The implement is suitable for attachment to most makes of Tractors with three-point hydraulic linkage.

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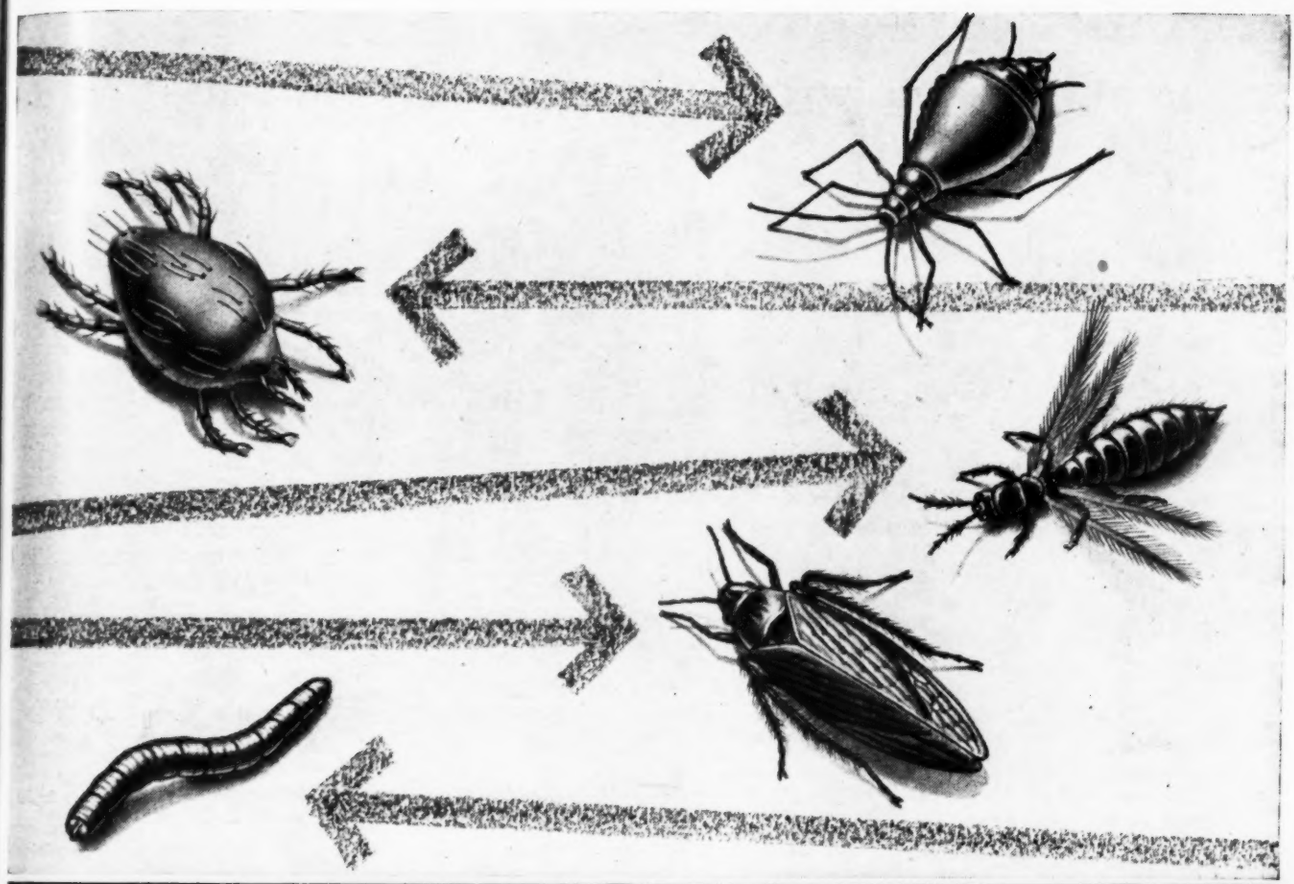

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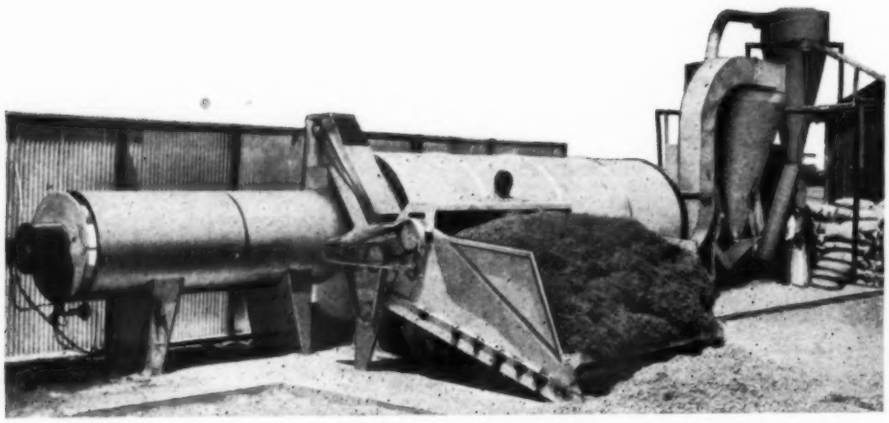

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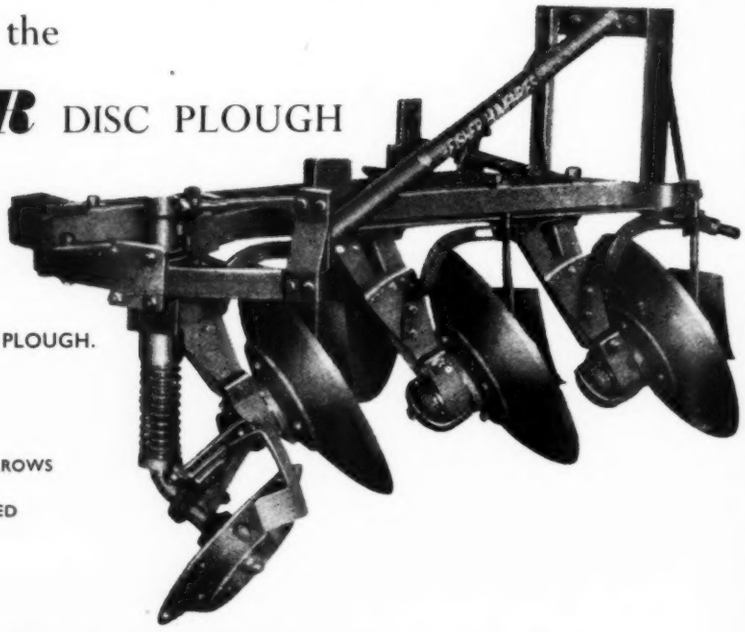

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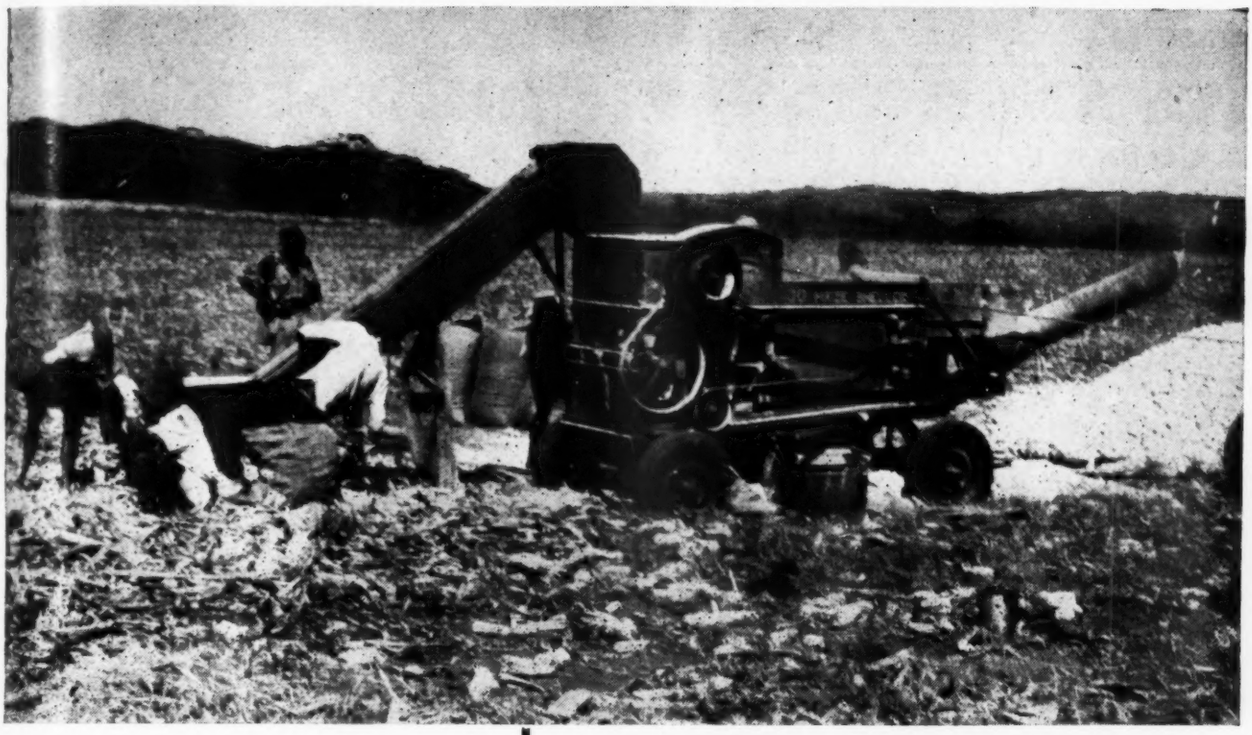

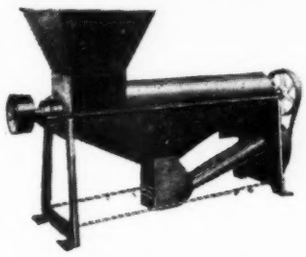

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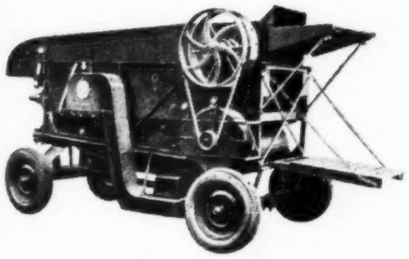

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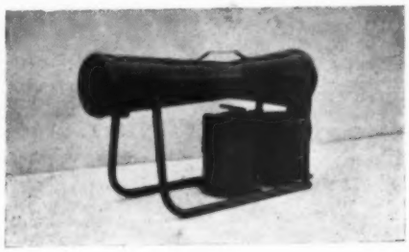

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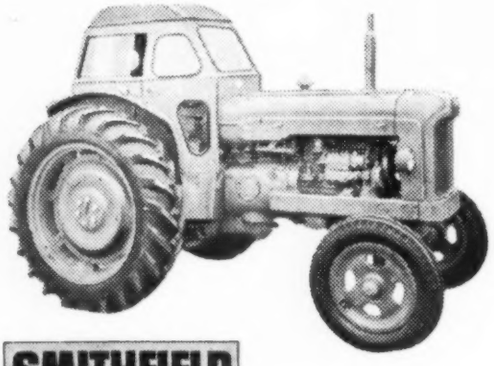

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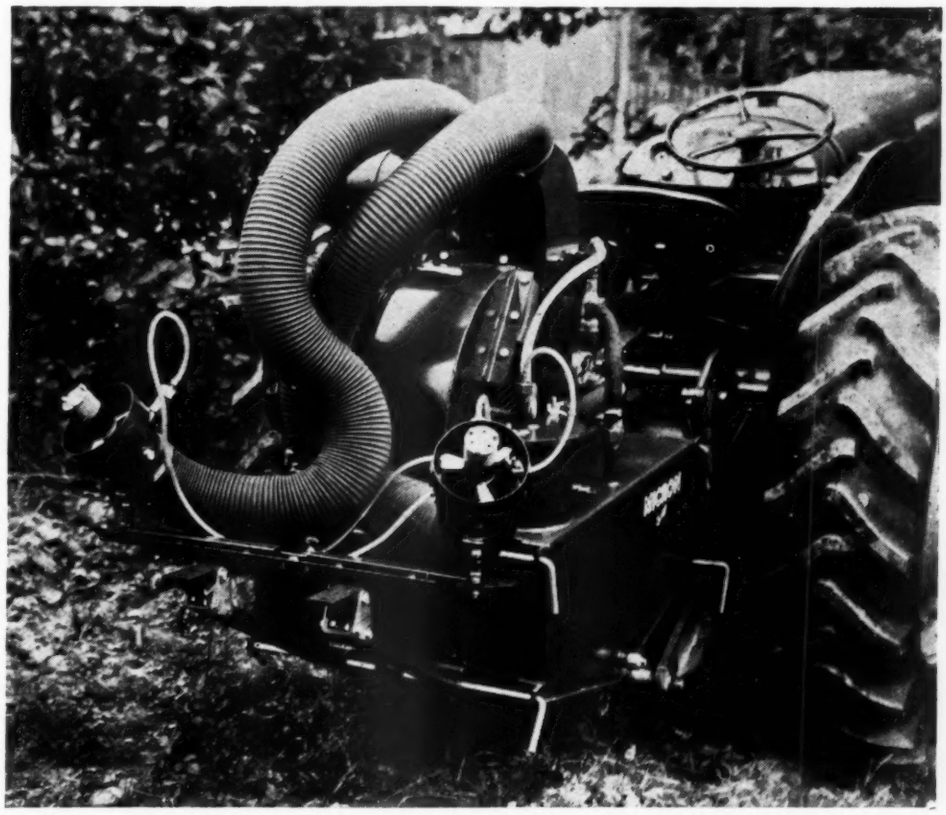

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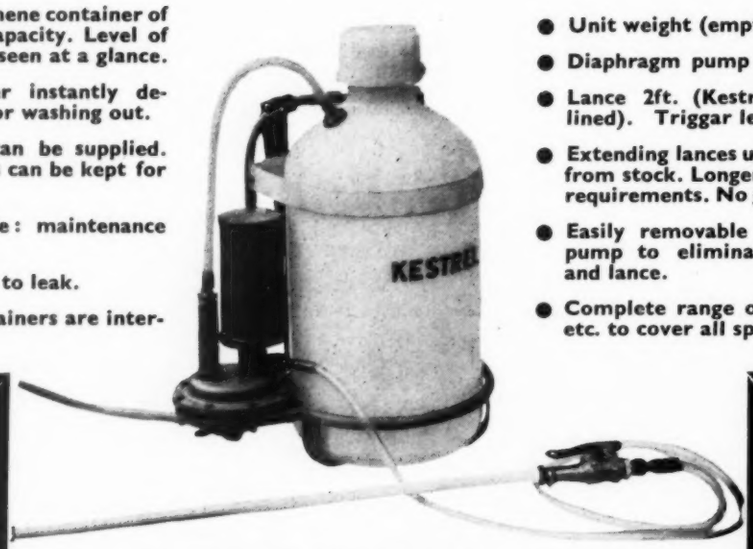

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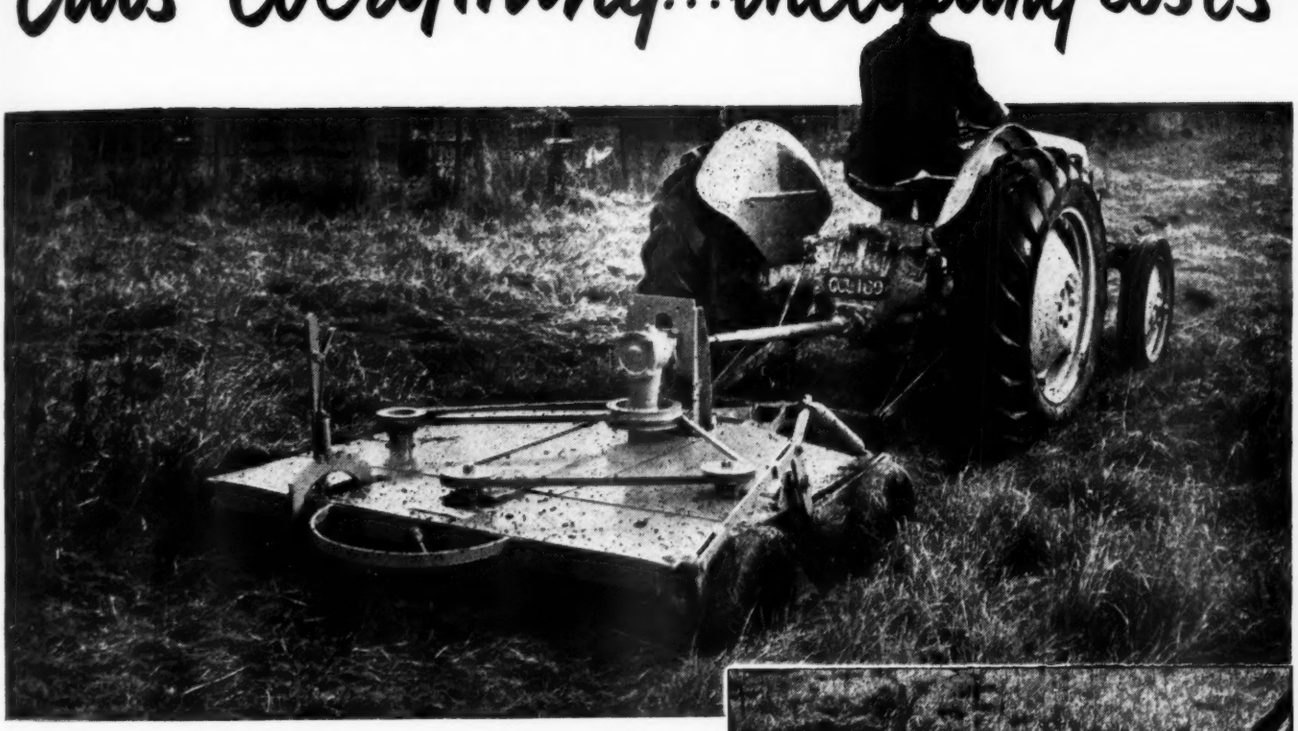

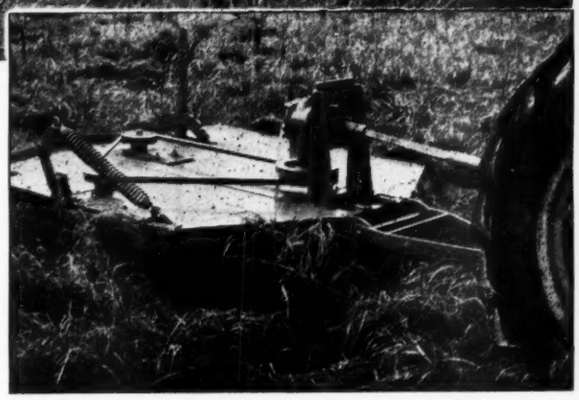

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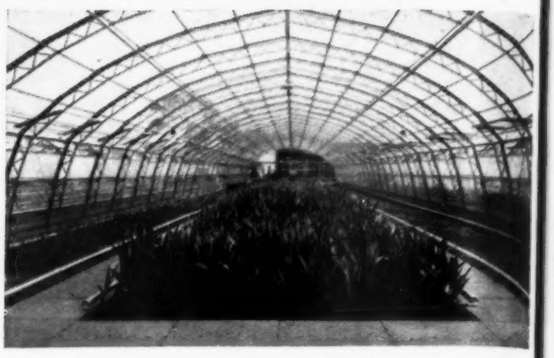

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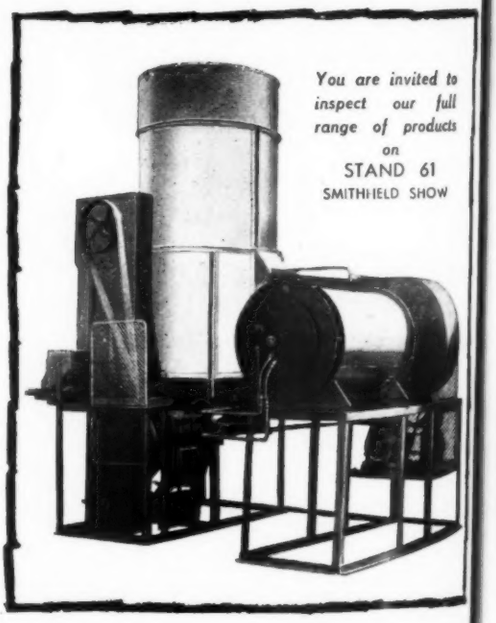

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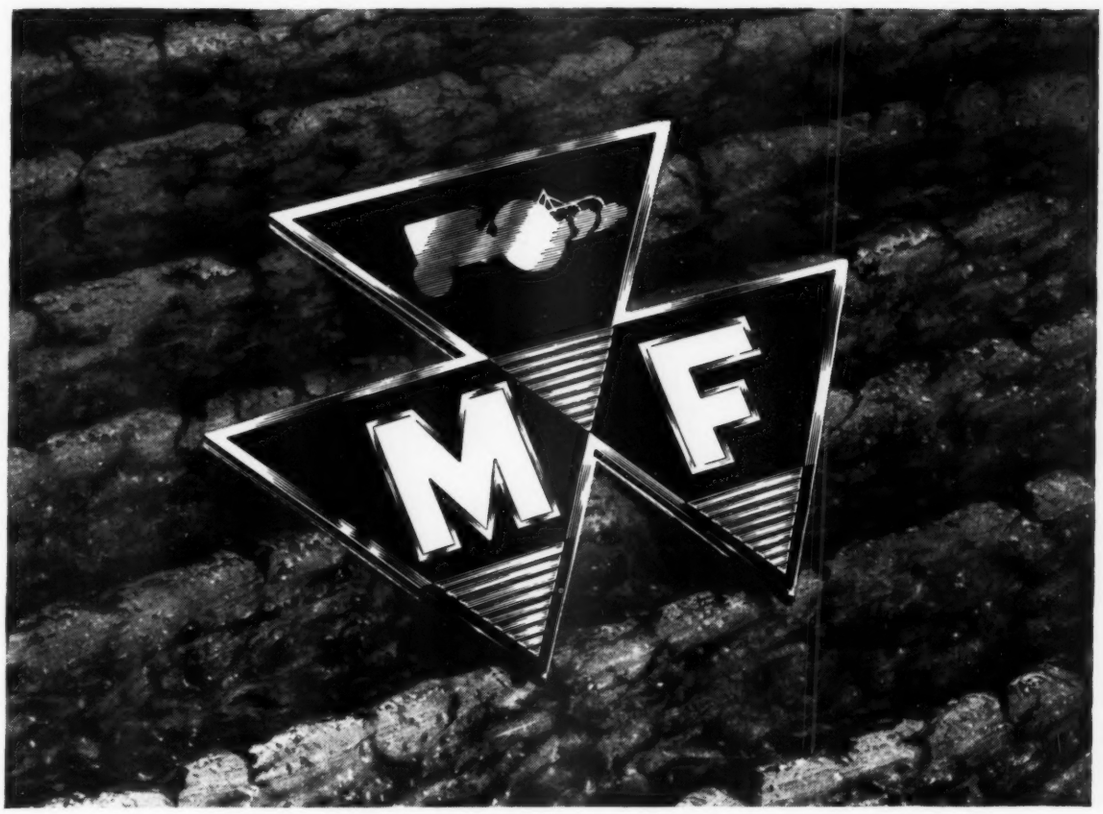

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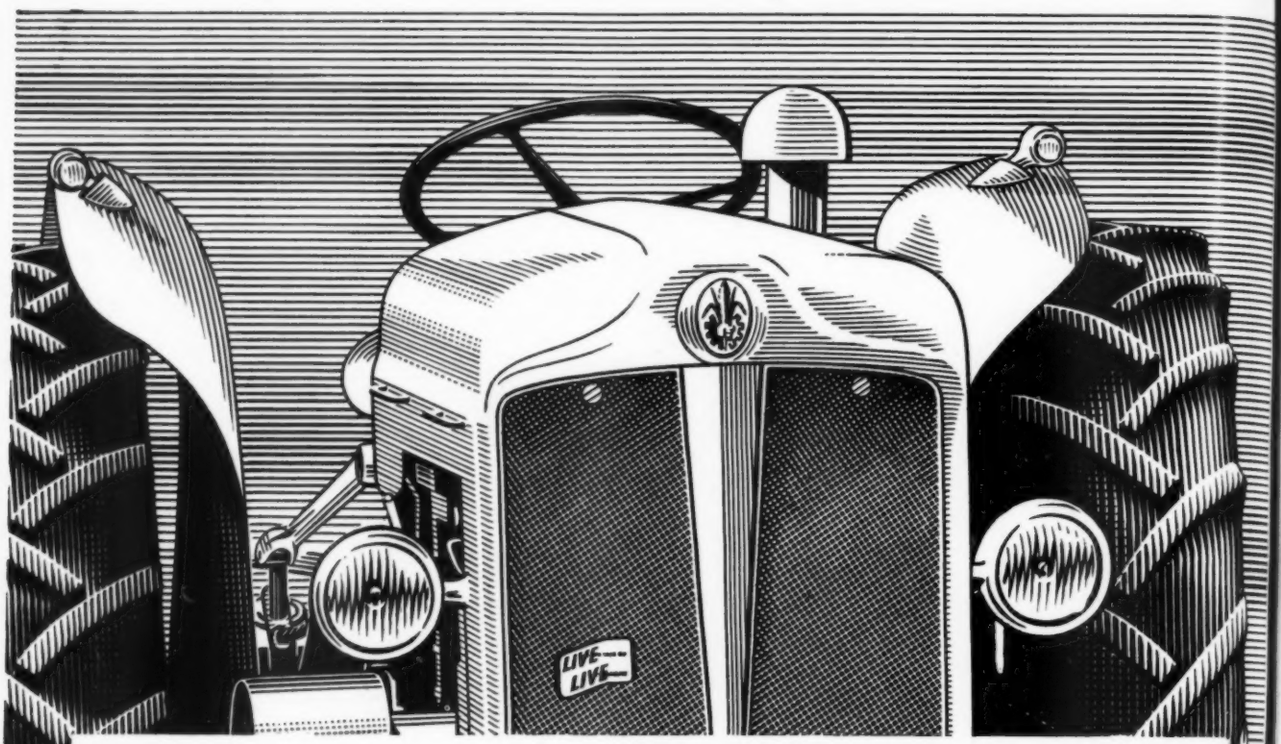

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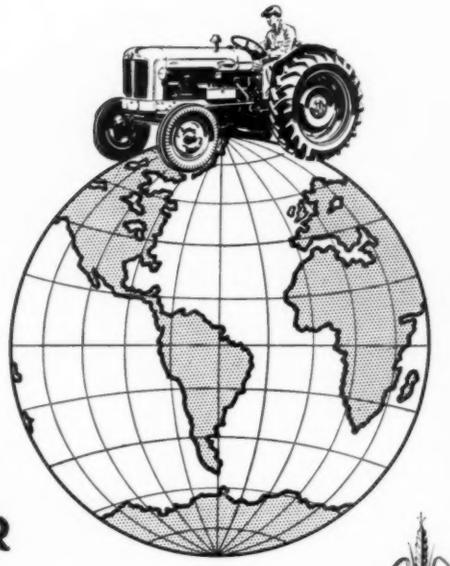

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Vol. 9, No. 12 — DECEMBER 1957

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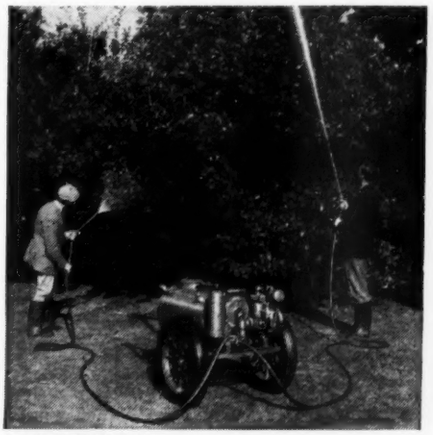

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Editorial Comment

Little Rock

IN THIS special number of WORLD CROPS, devoted to tropical crops, it is fitting to refer to the unfortunate events at Little Rock, Arkansas, for the controversy is not merely a domestic issue, but has an important bearing on East-West relations. It is necessary to put things in their proper perspective, for the Little Rock incident, while admittedly an example of extreme racial intolerance, is an isolated event which, because of its news value, has received altogether too much publicity. The fact is integration is, and for a long time has been, going on in the schools of America on a considerable scale without any undesirable incidents.

There are understandable differences between races due to their religious, historical, cultural and social backgrounds and to differences in climate, and also perhaps because of differences in opportunity; there are good men and bad men in all races; there is in some quarters still a colour bar, though in some tropical countries today there is also a colour bar working in reverse.

After 30 years of work in the tropics, visiting 37 countries and mixing with men of all races, creeds and colour and at all levels from ruling princes to poor peasants we have reached the conclusion that there is no room in the world of today for racial intolerance. The supreme problem of the world is neither the nuclear bomb, nor interstellar exploration, but the continuous increase in agricultural production and, above all, improved distribution in all parts of the world to meet the ever-growing needs of an ever-increasing world population and thus avoid the need for expansion by force. *This problem is far more acute than well-nourished people realise* and it will require the fullest co-operation of all men of good will if the health, wealth and happiness of mankind is to be secured.

Speaking in London last month, Prof. L. Dudley Stamp drew attention to the very alarming situation in Japan today, where people are struggling for an existence on less than one-fifth of an acre of land per head. For a 'luxury' diet, based on meat, milk and eggs, about two to two and a half acres are needed to support one human being. By concentrating on calorie foods, by double and even treble cropping of the land, and by applying more plant foods than any other nation (WORLD CROPS, 1957, **9**, 374) *the Japanese an claim to be many times more efficient users of land than any other nation in the world.*

It takes, he said, a little over one acre to feed a man under other conditions of agriculture; in the U.S.A. the amount of agricultural land under cultivation is something of the order of three and a half acres per head and in Canada about four, but, of course, both countries are very willing exporters of their surplus agricultural products; in the U.K. the figure of land available for agricultural usage is only 0.55 acre per head, and about half the food consumed in Britain has to be imported and paid for in consumer goods. In Japan their limited areas of agricultural land, which cannot be extended any more, amount to only 0.17 acre per head and the people have to exist on this, together with the harvest they can take from the sea.

It is obvious that the industrial potential of Japan must be increased in order to pay for the imported food which will be required by the steadily growing population and other countries must be prepared to produce that food and buy the industrial goods produced by Japan so that there may be a balanced economy—and peace.

Whither mechanisation?

THE URGENT need for rapidly increasing food production after the second world war directed renewed consideration to the possibility of bringing large areas into cultivation within a short time.

The unfortunate result of giving practical effect to this conception without adequate appraisal of the implications is well known, but failure in one instance through misconception of the difficulties does not mean that there is no future for mechanisation in tropical agriculture.

This applies in particular to rice production. Investigations have established the practicability of mechanising every stage of paddy cultivation and harvesting provided that soil conditions are suitable and irrigation control is adequate. Indeed, in the U.S.A. all stages of rice production on a large scale have for long been successfully mechanised.

While considerable progress has been made in solving the physical problems relating to paddy cultivation under difficult soil and water conditions, insufficient attention has been directed to its adaptation to meet the particular needs of the smallholder. *This is of great importance, since the bulk of production is, and must remain, in the hands of small producers, while land available for large-scale production is limited and in many cases the capital cost is prohibitive.*

Admittedly, difficulties in mechanising field operations on smallholdings are numerous, but are surely not insuperable. If the large amount of money being spent on investigations is to be justified, machines and techniques suitable for small-scale production must be forthcoming in addition to the expensive machinery for large-scale farming.

The Japanese appear to be leading the world in the application of machinery suitable for the smallholder,

while there is appreciation of the needs of the smallholder in India. Numerous Japanese publications show a wide range of such implements, their representatives are active in many countries, while the practical nature of their machines is evident by the greatly extended use they find in Japan.

We do not advocate any abandonment of investigations on large-scale mechanisation units, but would point out that future development of the smallholder must be anticipated by the provision of machinery, suited to his needs. In the enthusiasm for large-scale production his claims for consideration are apt to be overlooked.

Legumes in tropical agriculture

THE IMPORTANCE of legumes in agriculture is taken for granted and far too often the assumption is made that such plants fix nitrogen, forgetting that *nitrogen-fixing bacteria can only operate under certain conditions.* Ignorance or indifference regarding the incidence of nodule formation under tropical conditions is surprising in view of the great prominence now given to legumes in plantation agriculture. Suitability of a leguminous crop is almost invariably decided by its ability to thrive sufficiently to form a good ground cover, it being assumed that the plant will enrich the soil by the addition of nitrogen formed in the nodules.

It needs but a cursory examination of the roots to show that nodules may be few in number or even absent, although under other conditions they are numerous. While, therefore, a cover may exercise a beneficial effect on the soil—by adding organic matter and preventing weed growth, for instance—the amount of nitrogen contributed may be great or negligible, depending, as G. B. Masefield has shown,* on the species of legume and the water content of the soil.

The farmer may have little or no choice concerning the species he grows, for he must be guided by the necessity for a complete cover, but he may exercise considerable control over the amount of nodule formation, for Masefield shows that nodulation is exceptionally high in soils having a high water-table and is evenly distributed on the root system to a depth of about 9 in. (in contrast with nodule formation in Britain, which is generally near the soil surface and often in clusters).

Many practical implications arise from these two points. If nodulation may be increased by raising the water content of the soil, this soil condition may be achieved in a number of ways, such as irrigation, strip cropping, ridging, mulching and windbreaks. It is also evident that measures designed to increase nodulation must be applied so as to influence soil conditions at a considerable depth.

We have considered only the agronomics of the subject; there remains the study of species in relation to nodule formation. We know that wide differences exist and there, for the present, we must leave the subject. Masefield has brought his investigations to a most challenging point and further elucidation is awaited with interest, for the subject is of great importance to tropical agriculture. (See also article on page 479.)

* *Empire Journal of Experimental Agriculture*, 1952, **20**, 175; 1955, **23**, 17 and 1957, **25**, 139.

Survival of the fittest

THE RUBBER-PLANTING industry was recently astonished by the proposal made by the retiring chairman of directors of one of the biggest agency houses in Malaya that large estates should be sold for fragmentation and that big companies should open up new lands away from the towns and villages. ' It is not right to be a land hog simply because one was there first ', states Mr. G. M. Knocker. *The Planter*, official magazine of the Incorporated Society of Planters of Malaya, in a recent issue deals very severely with this would-be reformer, detailing facts which should be obvious to anyone who has ever had direct connection with a plantation industry.

Europeans were first on the spot simply because they introduced the Para rubber plant from Brazil into the jungle wilderness of Malaya in 1876 and painstakingly evolved the new industry, steadfastly seeing it through all its early hazards and difficulties. Today, rubber planting is indeed a mighty industry, involving technicians, executive and office staffs, and supplying extensive living quarters, hospitals, schools and the amenities and opportunities for work and promotion that go with a big organisation. These would certainly disappear with the fragmentation of estates. More fundamentally serious, however, would be the deterioration of the rubber stand and the fall in out-turn which would be inevitable under the smallholder, who has neither the money nor the desire to apply the necessary fertilisers, to control pests and diseases, or to employ correct cultural procedures, if he has sufficient for *his* simple needs.

It is common experience with plantation crops, when cultivated by peasants, that the return per acre falls far below what is obtained when the same land is worked on estate lines. The Director of the Tea Research Institute of Ceylon, writing in WORLD CROPS in May 1954, said that, in Ceylon, of the 70,000 acres owned by smallholders much is in a state which disgraces even the low standard of peasant farming. When smallholders take over productive and flourishing properties, the cultivation and level of out-turn fall almost beyond belief. In addition, the quality of the leaf plucked is inferior to that gathered on big estates. This fact lowers the general quality of mid-country teas in Ceylon, where peasant holdings are most numerous. Similar evidence is available in Java and in the Nilgiris in South India.

A tea estate requires about one labourer per acre per

day in the field, working a six-day week, so that a peasant with only an acre of tea must work every day, which he is seldom willing to do.

In East Africa the smallholder similarly fails, and it has been known for the peasant not to harvest his cotton crop because his coffee has done so well and has fully provided for his needs.

The main argument in favour of the smallholder is the sentimental one: he is a native of the country in which he happens to have been born. In a hungry world, however, sentiment carries little weight. In Great Britain, a native is not allowed to misuse his land, and if he does so he is replaced by others who will make the best of every acre according to established procedure. If a native will not do this, an outsider will. That is the lesson of history. It is apparent that in the present world struggle for *lebensraum* only the most efficient and the most intelligent can survive.

Billions of tons

YET ANOTHER of the world's essential raw materials is being developed in Canada—*the estimated 100-billion-ton deposits of potash*, which were first discovered in 1946, by boring to well over 3,000 ft.

It is reported in the *Financial Post of Canada* that a number of American companies now hold concessions in this area and one of these, the Potash Company of America, has already completed its shaft and a processing plant, and is ready to commence operations.

The total cost of this undertaking is said to be over U.S. $20 million, of which a quarter was spent on the preliminary work of proving that the deposits, despite their enormous depth, could be mined.

Canada's requirements of potash cannot be more than one-tenth of the projected output and by the end of 1958 *we can expect that Canada will become a major exporter.*

Clover and cereal crops

FURTHER RESEARCH into the effects of varying periods of subterranean clover pastures on soil fertility, and subsequent increases in yield and quality of cereal crops, is to be undertaken at the South Australian Department of Agriculture's research centre at Turretfield this year. According to Dr. John Russell, senior soil fertility research officer, who recently returned from the U.S.A., subterranean clover pastures could lead to increases in wheat and barley yields in nearly all cereal-growing areas.

It is not yet known how best to use legume pastures and crops in rotation to secure a balanced and efficient agriculture, and these long-term trials will show how farmers can achieve maximum production and best possible returns by means of such pastures.

Valuable information will be gained on the effect of nitrogen build-up, increase in stock-carrying capacity, crop yields and changes in soil structure from these investigations.

New hope of cactus control

THE NECESSITY for plant importation restrictions is not confined to the danger of introducing plant pests and diseases, but extends to the threat to agriculture of the plant itself. In the past plants have been unwittingly introduced which eventually occasioned widespread damage to agriculture. Thus the beautiful water hyacinth was introduced into many countries, only to become a dangerous pest. So, too, a single plant of the jointed cactus (*Opuntia aurantiaca* Linde), introduced into South Africa a hundred years ago as an ornamental plant, has spread over large areas in the Union, a total of about two million acres now being menaced by this plant. It is extremely hardy and will grow under widely differing climatic and soil conditions. It favours a comparatively low rainfall, a hot climate and a clayey or clay-loam soil containing calcium, conditions which are found in South Africa.

The official journal of the Department of Agriculture, *Farming in South Africa*, in its July 1957 number, outlined the mechanical, chemical and biological methods of control which over many years have been attempted to control jointed cactus and publicises a Government scheme to solve this national problem. Mechanical control entailed removal of every trace of the plant, a slow, time-consuming and well-nigh impossible task. Sodium arsenite and arsenic pentoxide applied to the weed up to about 2,000 lb. per acre killed the cactus, but adversely affected the soil for several years. Biological methods have given some control, but no eradication.

A recent series of tests with *hormone weedkillers* has shown that solutions of amyl and butyl esters of 2,4,5-T which contain 1.5 lb. of the active ingredient 2,4,5-T acid in 10 gal. of paraffin *destroy both top growth and tubers of jointed cactus* provided that every joint of the plant is sprayed. It is equally effective on prickly pear. It is considered that a subsequent spraying is necessary to ensure that every live particle of the plant is sprayed.

The Government scheme to eradicate the pest provides free spraying material, the farmer being responsible for its application and for subsequent spraying. Alternatively, the Government will carry out the entire work, charging the farmer 50% of the cost or, exceptionally, will grant a loan to cover the entire cost of the initial spraying.

Success appears to depend on its almost simultaneous application over the entire affected area and the wholehearted support of the whole farming community. Apart from control of livestock movement, rendered necessary because the weeds adhere to the animals and are thus spread over wide areas, no legal measures to compel the co-operation of farmers appears to be contemplated by the Government.

It is to be hoped that this voluntary scheme will receive the unanimous support of farmers, otherwise, as a measure to exterminate the pest, it is doomed to failure.

Bilharzia

BILHARZIA IS a disease of very considerable economic importance in agriculture. It is endemic throughout Africa, South America and the West Indies, China, Japan, the Philippines, Formosa, Burma, India and Western Australia. With a low-intensity infection the subject is able to live quite happily in his village without feeling any serious effects. However, if he leaves his village for industry or to undertake heavy manual work, whether on irrigation works or in plantations, he is liable to have an early and serious exacerbation of the disease. The disease is characterised by a discharge of blood and mucus, which is very enervating and, with a heavy infection, death takes place from toxaemia, from impairment of the liver and from complications caused by damaged organs.

Like malaria, bilharziasis or schistosomiasis is an example of a disease in which the causative worm has two hosts—man and the aquatic Bilharzia snail. As a result of the remarkable progress in the study of malaria, this disease has been virtually stamped out in India, Ceylon and Malaya, where formerly there were serious outbreaks of the disease, but, according to Dr. R. Ford Tredre, of the Ross Institute, progress in the study of schistomosomiasis lags behind that of malaria by at least 20 to 25 years. In Africa, he says, it is the will to get on with the job that is lacking. Lack of success in Egypt, lack of interest in this work in Africa generally and the consequent lack of skilled research workers has delayed the advancement of knowledge.

In the undisturbed condition of a sparsely populated countryside the numbers of Bilharzial snails in natural watercourses are limited by various factors: when Man interferes with these natural conditions, as, for example, in the irrigation system in the Gezira of the Sudan, which was formerly a desert, and in the clearance of the tropical forests of the Congo, conditions become favourable for an increase in the snail population and this is also aggravated by the influx of infected labour. The most favourable conditions are comparatively clear, still waters containing some vegetation and animal, human and vegetable refuse that would be associated with the usage of such waters by Man.

The construction of a reservoir or irrigation tank means the creation of a large surface of still water with an abundance of vegetation in the shallows in which the Bilharzia snails will flourish if the temperature of the water is favourable. If people habitually use the dam for washing their clothes or themselves, then vector snails will abound in the vicinity and will subsequently be carried in the irrigation waters to procreate colonies in the countryside.

Improved nutrition and diminishing reinfections enable a person to throw off naturally a considerable proportion of his intestinal worm load and with the drugs now available a fair proportion of those treated can be cured before irreparable damage is done. Dr. Tredre concludes that the control of the disease is a combined operation of such treatment and the elimination of the Bilharzial snails. Good village water points, a ' safe ' swimming place and well-located latrines are essential measures in the organisation of new irrigation schemes and the subsequent establishment of agricultural colonies.

Jack and the beanstalk

DURING THE past year articles have appeared in a number of technical and other journals about gibberellic acid, a plant growth stimulator of a completely new type. A brief and guarded reference was also made in this journal (WORLD CROPS, 1957, **9**, 265), which indicated that small quantities of the product could be obtained from Pfizer Ltd. for experimental purposes.

In view of the very fanciful stories which have already appeared, it is important for us to put matters in their correct perspective. Dr. J. Watson, Head of the Botanical Department of Rothamsted Experimental Station, in his address to the Biological Society of Great Britain last month, said, ' yield cannot be increased indefinitely by increasing the leaf area per acre because, as more and more leaves are crowded together on a unit area of land, mutual shading causes the mean rate of photosynthesis for the whole crop (*i.e.* mean rate of dry matter production per unit of leaf area) to diminish '. These results suggest that there is not much scope for increasing the yield of agricultural crops just by increasing the leaf area per acre.

In the subsequent discussion the question of the use of gibberellic acid to stimulate plant growth naturally was discussed. It was apparent that: (1) although it is possible to produce spectacular results with *individual plants growing alone*, the conclusions so reached are not applicable if the plants are grown under normal field conditions; (2) gibberellic acid does not increase the leaf area of all plants; (3) it can also induce undesirable characteristics, *e.g.* the ' bolting ' of sugar-beet.

Continued research on this product is obviously necessary. Plant Protection Ltd. have just produced a useful booklet entitled ' Gibberellic Acid ', which describes the history of its discovery, its physical and chemical nature and its biological and physiological properties, and also makes suggestions for experimental work.

There is also an interesting brochure on the 'gibberellins ' by S. H. Wittwer and M. J. Bukovac, of Michigan State University, U.S.A., which describes their origin, their general effects on the growth of horticultural plants and their other uses in the studies of plant growth.

Gibberellic acid is now being manufactured on a small scale by I.C.I. and small quantities only are available to *bona fide* scientific workers in the agricultural and horticultural fields. It is not yet being produced on a commercial scale for obvious reasons.

THE VALUE OF LEGUMES IN CROP ASSOCIATIONS IN THE TROPICS

G. B. MASEFIELD
(*Department of Agriculture, University of Oxford*)

The use of legumes in association with annual and perennial crops and with pasture grasses and tree crops in the tropics is reviewed. The author considers that further work in this important field of research is necessary.

IN a recent publication from Tanganyika[1] two pregnant sentences occur: 'Some confusion of thought regarding the use of legumes has occurred in the past, owing to the usual failure of legumes, under tropical conditions, to benefit a following crop. We now know that association is usually more beneficial than rotation, under tropical conditions, so far as nitrogen utilisation is concerned'. This is a conclusion towards which many tropical agronomists have been tending in recent years; but it seems that the potential uses of legumes in association with other crops are still far from being fully understood, and further still from being fully exploited.

Legume associations

The kinds of association between legumes and other tropical crops fall into five main classes:

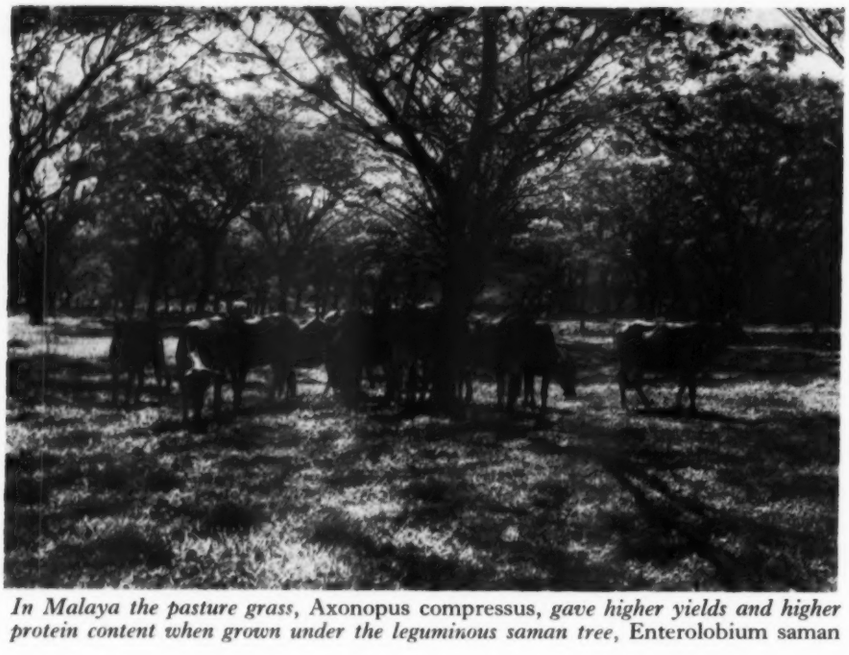
1. *Leguminous herbs associated with pasture grasses.*—Recent work in the temperate zone has established that clovers increase the yield and protein content of grasses grown in association with them. The most thorough investigation of this point has perhaps been by Sears and his co-workers in New Zealand. In a five-year trial, grasses, without clovers or manuring, yielded annually about 1,800 lb. dry matter per acre; the addition of white and red clovers increased this up to 11,000 lb., all species of grass used giving a higher yield in addition to the clover yield.[2] Without fertilisers an average nitrogen content of 2.31% for grasses in cloverless plots was raised to 3.49% by association with clovers.[3] These observations are not, however, applicable to the tropics except in the few places where, as at high altitudes in Kenya, some species of clover can be grown.

An increase in the protein content of molasses grass, *Melinis minutiflora*, grown in association with Kudzu, *Pueraria phaseoloides*, has been reported[4] from Puerto Rico. But not many associations between leguminous herbs and grasses are so far of much value in tropical pastures, where the legumes do not usually survive for long in the mixture, partly because they are preferentially grazed by livestock.

Another possible use for legumes in connection with pastures has recently

Photo: Malaya House, London

A mixed leguminous cover under young rubber trees



In Malaya the pasture grass, Axonopus compressus, *gave higher yields and higher protein content when grown under the leguminous saman tree,* Enterolobium saman

been indicated in Kenya.[5] Sweet blue lupins inoculated with *Rhizobium* and used as a nurse crop for the establishment of a *Setaria* grass ley may increase the grass yield to the same extent as 2 cwt. of sulphate of ammonia per acre. The effect of the lupins is stated to be most noticeable on the colour and growth rate of the grass.

2. *Leguminous trees associated with pasture grasses.*—Jagoe in 1949[6] showed that, in Malaya, the pasture grass, *Axonopus compressus*, gave higher yields and higher protein content when grown under the Saman tree (*Enterolobium saman*) and two other leguminous trees than when grown under non-leguminous trees, or in the open. Pastures have been established on this principle at the experiment station at Serdang with a sward of *Axonopus* and saman trees planted at a spacing where their canopies nearly meet, casting a light shade over the whole pasture. I was informed that these pastures have been able to carry cattle for a year with maintenance of body weight at the rate of one beast to 0.45 acres, a remarkably high figure for the tropics, and the Bali cattle which I saw on them were in excellent condition.

These results seem to deserve following up in other parts of the tropics and are of special interest in the savannah regions of Africa, where many leguminous trees occur naturally in the rough grazings unless they are destroyed by man. It is possible that an association of pasture grasses with leguminous trees may be of more value in the tropics than an association with leguminous herbs on the pattern of clover use in temperate regions.

3. *Leguminous trees associated with perennial crops.* — This association chiefly occurs where leguminous trees are planted as shade in such crops as tea, coffee and cocoa. Both leguminous and non-leguminous trees are commonly used in this way, and both are often beneficial; very little research seems to have been done on the contribution of leguminous shade trees to the nitrogen economy of the crop. Ten years' observations at the Tocklai research station in Assam led to the conclusion that the use of a leguminous shade tree, such as *Albizzia odoratissima*, may have the same effect in increasing the tea crop as an annual application of 400 lb. per acre of sulphate of ammonia.[7] Such observations are, however, much complicated by the light factor. It is known that both tea and cocoa respond less to fertilisers of several types when they are shaded, and this is true even if artificial shade is used rather than living trees.

4. *Leguminous cover crops associated with tree crops.*—Leguminous cover crops are perhaps most used at the present time under young rubber. In Malaya it is a common practice to sow a mixture of three legumes—*Calopogonium mucunoides*, *Pueraria javanica* and *Centrosema pubescens*. After a few months the *Pueraria* becomes dominant, but it is said that it does not establish itself so well without the others. The *Centrosema* persists longest in the mixture. Owing to the failure of cover crops in some areas in earlier days, a *Rhizobium* culture for inoculation was evolved by the Rubber Research Institute, using a strain which is claimed to nodulate with all the three species concerned. There is no formal proof that this is any more effective than naturally occurring strains, but some planters use it as an insurance. A shrubby legume, *Flemingia congerta*, has also been recommended by the Rubber Research Institute for use in young rubber, but has not yet been much planted in practice owing to the cover it affords to terrorists. After about four years the three-species mixture, already referred to, dies out, due to the increased shade of the rubber trees. At this stage some planters attempt to establish a more shade-tolerant leguminous cover, such as *Desmodium ovalifolium*.

Little exact work has been done on the comparison of leguminous and non-leguminous covers (of which *Mikania scandens* is the one most commonly planted). I was informed at the Rubber Research Institute that in one experiment the former had been shown to make more nitrogen available to the rubber than the latter. But more confirmatory evidence under varying conditions is needed, and the effect of leguminous covers has not been accurately compared with that of the natural vegetative cover slashed back. Many planters are convinced by their practical experience of the great value of leguminous covers; and certainly the excellent condition of the young rubber on some estates with such covers is impressive. Some planters claim[8] that the most economic manurial programme for young rubber is to broadcast phosphatic fertilisers liberally on the cover crop, which in their opinion increases its nitrogen fixation and thus indirectly supplies the rubber with nitrogen. This is exactly the same philosophy as that of the New Zealand grazier, who applies phosphate to his pastures to stimulate the growth of clover and so supply the grass indirectly with nitrogen.

In young tea, *Vigna oligosperma* is the most popular cover crop in Ceylon and Malaya. In Assam, the bushy *Tephrosia candida* is interplanted as a two-year crop in young tea; it is hard to know whether to classify this as cover crop, green manure or shade. Again, it is reported that phosphatic manures greatly stimulate the *Teph-*

rosia and it is claimed that this is beneficial to the tea. In coffee the use of cover crops seems to be declining in favour of mulching, which is certainly a very beneficial treatment. In sisal, leguminous cover crops have been tried in East Africa, but the results have not been good enough to secure the acceptance of this method in practice.

5. *Leguminous annuals associated with other annual crops.*—In much peasant agriculture in the tropics leguminous crops are interplanted with cereals and occasionally with root crops, and the persistence of this practice suggests that it has something to recommend it. This may not necessarily be due to a nitrogen contribution from the legume, since mixed cropping has other advantages, such as the provision of a closer leaf canopy over the soil, which tends to limit soil erosion. But in many parts of the tropics it can be shown that if two separate acres of a cereal and a leguminous crop are compared with two acres of both crops interplanted the latter gives the higher total yield. This knowledge is only a beginning in agronomic problems, for such results may only be obtainable by sowing the crops at defined spacings to give the best combination of populations, which may lead to the peasant having more of one of them than he needs for his subsistence or wishes to market. Furthermore, interplanting of crops becomes less practicable as mechanisation of agriculture increases, for two or more crops do not usually ripen at the same time, nor if they do can they generally be harvested by the same machinery. Interplanting is therefore usually only found in manual systems of agriculture.

Replanted rubber growing in terraces with strips of mixed leguminous covers between the rows

A series of experiments was undertaken in Uganda some 20 years ago on the effect of interplanting cotton with beans or groundnuts. Such interplanting was shown in many cases to be profitable to the cultivator, but often the combination was least satisfactory in districts with the lowest rainfall and highest temperature, or when the two crops were planted so late after the start of the main rainy season that they did not obtain the full benefit of the rains. This suggests that interplanting may make it more difficult for the plants to obtain their full water requirements under conditions of stress than in pure cropping, a supposition that may well be the key to a rational use of interplanting. Tropical farmers themselves seem to use mixed cropping less in arid regions than in ones with a high rainfall.

There is possible scope for interplanting in one case where the need for water economy does not arise, *i.e.* in flooded rice fields. It has recently been found[9] in South India that *Sesbania aculeata* can be profitably grown round the edges of rice fields and subsequently pulled up for working into the soil before the next rice crop. While this is in the main an instance of green manuring, the *Sesbania* is in the ground at the same time as the rice crop and part of the benefit may come from association, though it is only known that it does the rice no harm. Observations in Malaya[10] have, in fact, shown that paddy-lands provide an unusually favourable environment for the nodulation of certain leguminous plants.

Photo: Natural Rubber Development Board

A leguminous cover crop, Centrosema pubescens, *growing in association with young rubber*

Economic considerations

In summing up the potentialities of legume associations, it may be objected that artificial fertilisers provide in general a cheaper and more accessible source of nitrogen than do the symbiotic bacteria. This is certainly not true in some remote and undercapitalised parts of the tropics. Where it is true, it is largely due to the research and effort that have been put into the production and distribution of nitrogenous fertilisers. Were an equal amount of study to be devoted to the best means of using legumes to maintain soil fertility, it might be found that the cost of nitrogen fixed by the symbiotic bacteria could also be considerably reduced.

(For references please see page 484)

A tea factory in the highlands of Ceylon

THE QUALITY OF TEA

Part I—The liquoring properties of varieties of tea

C. R. HARLER, PH.D.

The information contained in this article is assembled for the first time. It will be of value to those engaged in the tea industry and of interest to all those who regularly partake of the cup that cheers and refreshes.

THE quality of a 'black' tea infusion depends on a number of factors, among which the following are important: (*a*) the climate of the area in which the tea has been grown, (*b*) the phase of growth during which the leaf was harvested, (*c*) the fineness of the leaf and (*d*) the process of manufacture. Of fundamental importance, however, is the variety of the bushes which make up the stand, and of still greater effect on quality are the inherent properties of the individuals which make up the variety.

Although tea farmers in China and Japan ascribe certain tea characteristics to the land on which the bushes are grown, there is no scientific evidence from the plantations in India, Ceylon or Java to support the opinion that particular physical or chemical properties of the soil affect the qualities of the tea. Nitrogenous manures, in any form, organic or chemical, may slightly influence quality adversely, although observations of this point are not consistent. Potash manures have no apparent effect on the quality of Assam teas, but tend to improve those in Ceylon. Phosphatic manures seem to have some good effect on the quality of Assam teas, but none on those in Ceylon.

Varieties and sub-varieties

Tea plants all belong to one species, *Camellia sinensis* L. (Kuntz), within which botanists recognise two varieties, the var. *sinensis*, the true China bush with small, mat leaves, and the var. *assamica*, a tree 15 to 60 ft. high with large, shiny leaves.

Under natural conditions of growth the two distinct varieties have been freely crossed and the distribution of the species over a wide range of climates has resulted, over the ages, in the evolution of a number of distinct sub-varieties which are today recognised by the tea industry. Seven commercial groups of tea plants are listed below:

Group 1. The true China variety, a small-leaved bush which is cultivated in the Yang-tsi valley and south-east China, Japan and Formosa. Tea farmers in these countries recognise many sub-varieties within the group.

Group 2. The so-called China-hybrid plant, which covers a wide range of forms. It may be a cross between the true China bush and the large-leaved China tree, described under group 3 below, or between the China bush and any of the other sub-varieties. China-hybrids are grown in Darjeeling and in the up-country districts of Ceylon, because they give quality and flavour in those areas. They are also grown in Ranchi, Dehra Dun and the Kangra Valley in northern India, and in Iran, Turkey and Georgia, U.S.S.R., largely because the climates of these areas are too severe for the more delicate large-leaved plants.

Group 3. The large-leaved China plant, a small tree up to 16 ft. high, indigenous to Sze-Chuan and Yun-nan in western China, in which areas it is cultivated. This type and the four following are all included by botanists in the variety *assamica*.

Group 4. The Cambodian plant, a tree 15 to 30 ft. high, occurring naturally in Indo-China and along the Annamite range, and also probably in southern Yun-nan. It has shiny, turned-up leaves which have a reddish tinge in the autumn. This type is a poor yielder and gives tea of inferior quality, therefore it is avoided.

Groups 5 and 6. The Burma and the Assam types, which include plants covering a considerable range of leaf size, texture and colour. These sub-varieties are trees 15 to 30 ft. high and may be good yielders of quality tea. They are planted in most areas where the climate suits them, exceptions being Darjeeling and up-country Ceylon, where the flavour given by China-hybrid plants outweighs the benefits derived from other types.

Group 7. At the end of the range of tea plants is the Lushai sub-variety, a tree up to 60 ft. in height, with large, flabby leaves up to 14 in. long, having a dependent pose on the stem and a sharply defined apex. This type gives poor quality and is not favoured by planters.

To sum up, it may be stated that the small-leaved bush is used in China, Japan and Formosa, the large-leaved China tree is grown in western China, and China-hybrids are planted in Darjeeling, up-country Ceylon and in Ranchi, Dehra Dun, Kangra Valley, Iran, Turkey and the U.S.S.R. The Assam and Burma types are planted or preferred in North-East India, South India, low-country Ceylon, Indonesia, East Africa, Malaya and the plantations of Indo-China.

The large-leaved types will grow in Darjeeling and up-country Ceylon, and they also flourish in southern China and Formosa. In Japan two Assam-China crosses, suited to the manufacture of black tea, are in commercial use.

Jats, agrotypes and clones

In Assam, for about a century, planters have been selecting types which field observation indicated were good yielders and experience showed were suited to particular areas. From these selected plants seed was taken from particularly good ones, or promising plants were taken from nurseries and from this material tea seed gardens were put out and the seed given its so-called *jat* name, usually taken from the estate on which it was grown. A *jat* may be of any sub-variety, two different *jats* may be practically the same, or a *jat*, if not closely selected, may include several types of bush. Tea seed gardens are steadily

de-rogued of trees which the planter does not like the look of and, as a result, the *jat* is always being modified, usually for the better, as plants showing Lushai, Cambodian and China characteristics are eliminated. All the *jats* used in the plains of North-East India today are of the Assam or Burma strains.

Since 1930, scientific selection has made great progress and a close definition of bush type is now possible. When plants of a certain species adapt themselves by natural selection to the conditions of a certain locality the resultant group is called an *ecotype*. From the tea ecotypes in Assam the planter chose the individuals he liked the look of to comprise a *jat*. A number of like plants from an ecotype constitute an *agrotype* and is probably a cross of some sort. Two similar looking agrotypes need not breed true from seed, because their genetic make-up may be, and probably is, different.

The large-leaved varieties of tea are, in the main, self-sterile and individuals are fertilised by crossing with another plant, which is the reason why tea seed need not produce plants like the mother tree. The only way to be sure of getting plants identical with the one selected is to propagate vegetatively. Plants thus grown from a single parent constitute a *clone* and all cuttings of the first or subsequent generations belong to the clone.

Not only can individual, selected clones be good yielders and show resistance to certain diseases, but they may also give teas of outstanding quality. Indeed, so great can be this last potentiality that it may outweigh the benefits to be derived from careful manufacture and even those from fine plucking. In some cases clones have been found which still produce quality teas in the usual non-quality period.

Thus the classification of the tea plant has been progressively more closely defined, from the species to the variety, to the sub-variety, the ecotype, the *jat*, the agrotype and finally the individual, the clone.

Tea processing

Before going on to discuss the teas of certain countries it is desirable to describe briefly the preparation and manufacture of 'black' tea and to correlate the various processes with the properties of the final product.

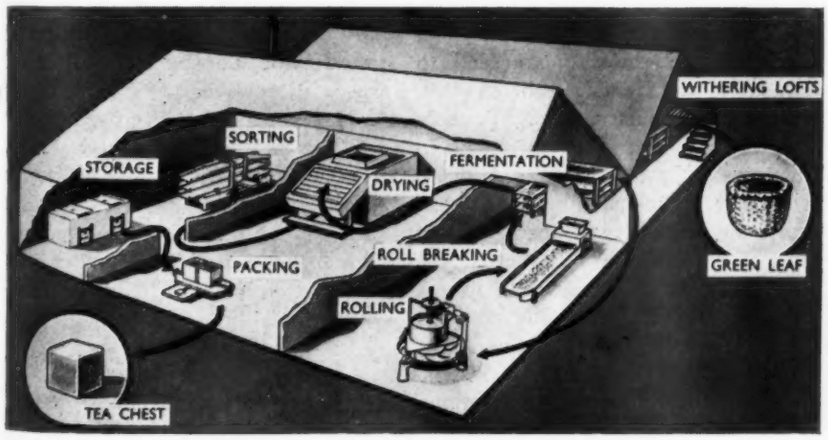
If fresh leaf, after plucking, be steamed or placed in a pan heated to dull redness it is killed. When such leaf is rolled and dried the so-called ' green ' tea is produced, which gives a pale yellow liquor, very different in taste and aroma from black tea.

To make black tea, fresh or withered live leaf must be bruised, crushed or rolled so that the leaf cells are damaged or distorted, their contents mixed and the leaf juices exposed to the air. Oxidation of the polyphenols within the leaf cells then takes place with the aid of leaf enzymes. The resultant bright red oxy - polyphenols thus formed rapidly polymerise or condense to form red and then brown products which account for *briskness*, *strength* and *colour* in the tea infusion. At the same time, other entirely distinct reactions occur which develop the *aroma* and *flavour*.

These changes were originally miscalled ' fermentation ' and the term has persisted. If they are allowed to go on too long, *colour* is enhanced at the expense of *briskness* and *strength* and a *flat*, *soft* or *dull* tea results.

When the fermentation process has proceeded far enough to develop a nice balance of liquoring properties it is stopped, either by throwing the leaf into a pan heated to dull redness, as in the China hand process or by a blast of hot air in a tea-drying machine, as used in the plantation industry. The leaf is finally dried till it contains about 3 to 5% moisture.

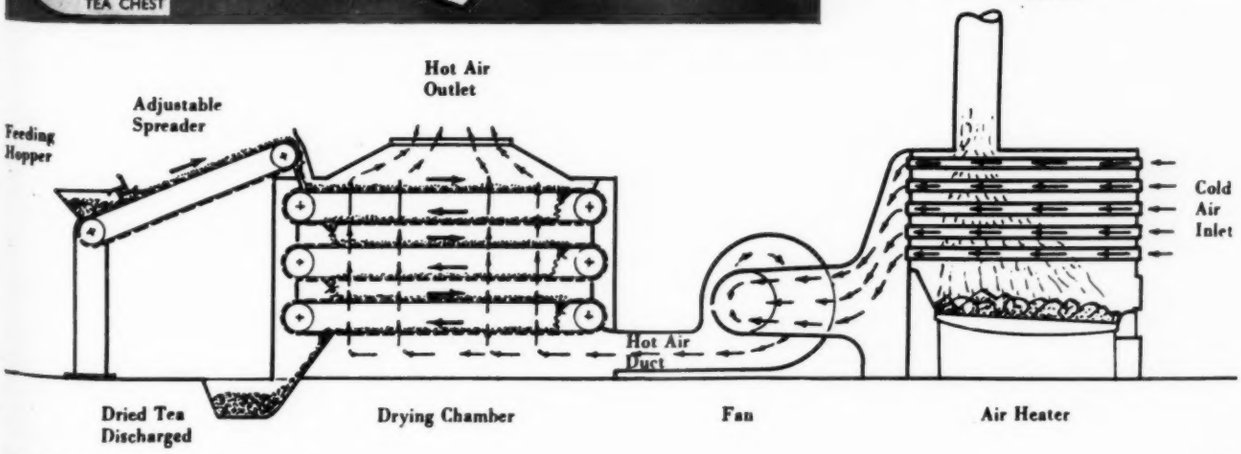
During the withering process of black tea preparation chemical changes take place in the leaf which make for *quality*, using the term in its narrower



(Left) *Diagram showing the various stages in the processing of tea*

(Below) *Diagram showing details of a modern pressure tea drier*

Diagrams, and photo on opposite page, Tea Bureau, London



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sense, a most valuable asset. In India and Ceylon it is considered that the wither should last about 18 hours to develop quality to its maximum. In addition to the chemical changes involved, the leaf withers physically and loses water. The chemical changes proceed whether the physical wither is completed or not.

Exactly what constitutes *quality* from the chemical point of view is not at present known. *Quality* is easy to recognise in a tea liquor, being partly smell and partly taste, but it is difficult to define. *Quality* goes with *brightness* and *briskness* of liquor. A too short or a too long fermentation period does not give the maximum *quality*, either because it has not had time to develop to its final form or because it is dissipated, or perhaps because it is masked by other products present in under- or over-fermented tea.

Tea tasting

The discussion of how a taster describes and evaluates a tea liquor is beyond the scope of this article, although brief mention will be made of some aspects of the subject.

The colour of the liquor should be *bright*, and this property indicates the amount of condensed oxy-polyphenols present and their degree of condensation. When the liquor is swilled round the mouth the thickness is judged by its viscosity, and this, together with its bitterness, tasted on the back of the tongue, and its sourness, tasted on the sides of the tongue, and its astringency or pungency, a sensation realised on parts of the cheek and the gums, make up the *briskness*, *strength* and *body* of the liquor.

Aroma and *flavour* are not tastes, but are detected by the olfactory nerve in the nose, reached either through the nostrils or from the back of the mouth. The complex aroma of tea is unique. It includes the acrid, herbal smell of fresh leaf in the field, a slight caramel smell as of burnt sugar, a smell of flowers and perhaps of alcoholic and amino bodies.

According to some tasters, *quality* bushes can be detected by their smell in the field, which would indicate that part of this important property is realised by the olfactory nerve.

The taster also examines and smells the dry leaf and the infused leaf, correlating their properties with the taste before he makes an evaluation.

Barley for Brewing

After the Plant Breeding Institute at Cambridge has produced a new hybrid barley the next step is for the National Institute of Agricultural Botany to determine its agricultural possibilities. At this stage, too, the new grain will be tested by the Brewing Research Institute for its malting and brewing characteristics. Often there will be an immediate rejection—not on a superficial appraisal, but after systematic examination and analysis and small-scale malting and brewing trials.

A unique small-scale plant has been built which allows complete control with versatility of operation and it has already resulted in an important new development in malting technique—the use of coumarin in the steeping liquor—which has reduced the losses in processing by 10%, so that, in effect, more malt is obtained from a bag of barley. Another important result from these trials was that certain varieties showed inadequacies in malting, and so dormancy trials were carried out which will lead to investigations on methods for overcoming dormancy.

The agricultural characteristics are determined by actual field trials and the results are finally considered by the Barley Advisory Committee. A variety approved for further trial is then multiplied and produced in larger quantities for semi-large-scale trials in the brewery to determine its fermentation characteristics, whether the resulting beer will give the right kind of head and, most important, whether there is an absence of 'haze' in the beer. While it is possible to assess quality analytically, nuances of flavour require a panel of tasters. The personal factor is ruled out by the statistical analysis of the opinions of the panel.

Finally, the approved barley has to be multiplied for distribution and its name is then included in the recommended list, with its grading on a system of marks.

At the time of going to press we learn that 'Proctor' barley, grown in a sandy soil in Somerset by Mr. C. Willy, won the malting barley competition at the Brewers and Allied Trades Exhibition, which was held in London recently.

Agricultural Engineering

The British Society for Research in Agricultural Engineering has agreed to initiate a membership scheme with effect from 1 January, 1958. Membership is open to anybody interested in furthering the aims of the Society, which are, amongst others, 'to promote research, development, testing and other scientific work bearing on the design, construction and use of agricultural and horticultural machinery, implements, equipment and appliances'. The Society is responsible for the running of the National Institute of Agricultural Engineering and its Scottish station. It is also engaged in the publication of test reports and of the results of experimental and development work in general. It is hoped to hold a Members' Day at the Institute and at the Scottish station. Members will also be able to make use of the library and information services.

Applications and enquiries should be addressed to the Secretary, Membership Scheme, British Society for Research in Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire.

Weeds in Groundnuts

A five-minute, 16-mm., full-colour sound film, showing how to control weeds in rows of groundnuts, using 'Crag Sesone', has been released by Carbide and Carbon Chemicals Co., of New York. The film shows how to prepare the weed control spray and calibrate the sprayer. It also explains how a grower can obtain greater profit by using a chemical herbicide to destroy weeds the easy way.

The Value of Legumes in Crop Associations in the Tropics

(*Continued from page* 481)

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RICE

H. W. JACK, O.B.E., PH.D.

(Formerly Agricultural Adviser to the Commissioner General in South East Asia)

There is no more important crop in the world today than rice; it is the staple food of the teeming millions of South-East Asia, whose numbers are increasing rapidly. The continued increase in rice production is one of the major world agricultural problems.

EACH year some 220 million acres of land are planted with rice and the harvest yields some 130 million tons of human food, as well as several million tons of animal feeding stuffs. More than 90% of this total is grown in the area known as South-East Asia, where the aggregate population exceeds 1,200 millions of people of different races; the remainder is grown mainly in Spain, Italy, Egypt, Brazil, Madagascar and the U.S.A.

Puddling a flooded paddy field with a pair of oxen in Indonesia

Photo: Shell

In South-East Asia, agriculture is by far the most important industry and provides permanent employment for the vast majority of the population. This area is also the main source of the world supplies of tin, tea, rubber, pepper, spices, sago, tapioca, jute, silk and manila hemp, linseed, and also tung, sunflower, coconut and palm oils; it also produces considerable quantities of tobacco, wheat, sugar, pineapples, bananas and other commodities, but of all these, rice is by far the most important crop from every aspect.

This was the view in China as long ago as 2800 B.C.; rice today is the staple food of approximately half the population of the world. In the past, when rice was cheap and plentiful, its cultivation was given little consideration or practical encouragement *In periods of prosperity the question of increasing production was generally neglected and in periods of economic depression lack of funds also caused the neglect of this basic industry.*

Way of life

The production of rice in South-East Asia is a traditional way of life with the various races of people—Burmese, Siamese, Ceylonese, Indian, Indonesian, Chinese, Japanese, Malayans and others—and the result of their labours is the basis of the national economy; *without rice there would be starvation, stagnation and stark economic ruin, as all labour employed in industry in these countries depends on rice.*

Rice growers in this region are mostly smallholders. The size of their properties rarely exceeds 10 acres; in many territories it averages only two or three acres, and in some areas much less. Hence the standard of living amongst rice growers is not high, but their needs are few and acute economic distress amongst them is virtually unknown, except when they fall into the clutches of moneylenders. In addition, with about 70 to 90 days' work a rice grower can provide the rice requirements of his family for the year, even leaving some over for sale. He usually possesses numerous ducks and hens, one or more pigs (in non-Mohammedan areas), one or two draught animals, coconuts or sugar palms for oil and food, a few fruit trees, some vegetables, sometimes tobacco, and nearly always plenty of fish. Many town dwellers in rice-producing countries are, in fact, poor by comparison with the rice farmer living on his own smallholding. Moreover, in the slack season he can find other employment, such as house building, fishing, carpentry, jobs in forests, on the roads, in clearing canals and drains, on the rubber, tea and coconut estates, on tin mines and in various other ways. Such tasks assist him in the purchase of the ubiquitous bicycle, a sewing machine, gramophone, a radio and his ordinary household requirements.

Water requirements

The wide distribution of the rice crop in the world indicates that it is adaptable to a wide range of soil and water conditions; but it requires warm, dry, sunny weather for harvesting. In rice cultivation, however, the greatest need is for abundant and controlled water supplies, since satisfactory yields require the application of the right quantity of water at the right time.

In general, these requirements are known from long experience. The average requirements of this crop are

(Above) *Thailand—collecting rice seedlings from the nursery bed for replanting*

(Left) *Indonesia—women transplanting rice seedlings in a paddy field*

about 6 ft. of water, including the rainfall during the growing season. If the rainfall is adequate and reasonably distributed, no irrigation is necessary, but, unfortunately, in many rice areas rainfall is unreliable and some supplementary irrigation is necessary to obtain good yields, especially as the needs of the crop vary at different stages of its growth. Immediately after transplanting, little water is necessary for a few weeks until the roots become established, after which stem growth becomes rapid. The maximum amount of water is required at this stage until the ears begin to emerge; a shortage of water now will adversely affect yield. As soon as the grain reaches the dough stage the water supply is cut off and the land is drained.

Rice farmers know by bitter experience that their water supplies must be assured if they are to rely on good crops and hence traditionally they spend much ingenuity, time and arduous labour in devising and carrying out water-control schemes. The steep slopes of the mountains of Java, terraced with contiguous, narrow and small rice fields reaching up to 4,000 ft. or more, serve as a lasting monument to the ability and energy of past generations of rice growers. Similarly, in Ceylon, China, South India and other countries water wheels, hand-, foot- or animal-powered pumps or scoops and other ingenious devices have been used through many generations to provide the necessary water.

In the last few decades governments, too, have realised the pressing need for assistance to rice growers by the provision of water and substantial progress has been made in many territories with skilfully engineered irrigation schemes, both large and small. This not only serves as a direct encouragement of rice production, but also keeps the people on their lands.

In some countries it is customary for growers to pay a small rate for the water supplied, as in Malaya. In others no charge is made for the provision of water, but an indirect return accrues to the government through rice export taxes or through increased trade in this commodity. Large areas in India, Thailand, Ceylon, Australia, Malaya, Korea, Japan and the U.S.A. have been adequately drained and irrigated to render them suitable for the cultivation of this crop simply as a form of national investment.

Experience has shown that irrigation alone with the customary methods of rice cultivation will, in no small measure, rehabilitate and maintain the fertility of the area irrigated. Material increases in the areas of land irrigated for rice are especially needed in South-East Asia, where the increase in population is variously estimated at between 12 and 15 millions every year, some 10 millions of which are rice eaters.

The cultivation of rice may be divided into two main classes: (*a*) upland or dry-land rice and (*b*) lowland or wet rice cultivation.

Dry rice cultivation

Dry rice cultivation on undulating and hilly lands is exhaustive of the soil nutrients, since rarely is any fertiliser used or any weeding done, with the result that planted areas are usually abandoned after two, or at most four, crops. In the simplest and rather primitive method there is no tillage of the soil; the virgin jungle is merely felled and burned and the seed is broadcast or sown in shallow depressions about a foot apart, made with a blunt stake. This type of rice cultivation is wasteful of economic timbers, is detrimental to the forests and, if not checked, is likely to affect watersheds adversely, resulting in soil erosion and floods on a large scale, as in Sarawak, Sumatra, northern Thailand and elsewhere. It also results in large areas of abandoned and impoverished land becoming densely covered with pernicious grasses and weeds, which retard the regeneration of the forest with consequent economic loss.

Another method of dry rice cultivation is frequently followed in the large areas of flat or gently undulating land to be found in Fiji, Kelantan, Ceylon, parts of Thailand and India. This method depends for its success on thorough tillage of the surface soil and on the rainfall, which in some areas may be unreliable. When the rice season begins, the lands are cultivated, sometimes thoroughly, but too often only scantily, because of slackness, unsuitable weather or shortage of tillage

animals. These may be either water buffaloes, as in Java, the Philippines or Thailand, or bullocks, as in India, Burma and Fiji. No manures are used and the tilth rarely exceeds 4 in. in depth.

The seed, usually pre-germinated, is broadcasted. Weeding is rarely practised, unless unfavourable weather retards the growth of the seedlings. When all conditions happen to be favourable good crops, up to about one ton per acre, can be obtained by this simple method of cultivation, but yields quickly begin to fall off and, after three or four years, the land usually has to be fallowed for several years. Occasionally, however, some rotation-cropping is practised, the alternative crops being maize, groundnuts, chillies, dhall, soya-bean or vegetables.

View overlooking terraced rice fields near Gaerot, Java

Wet rice cultivation

In lowland rice cultivation the idea is to puddle the soil to a homogeneous mass of sticky mud, into which well-grown seedlings can be transplanted. The puddling is generally achieved by ploughing, harrowing and rolling. Often very primitive implements are used, but even with these surprisingly good results can be obtained. In some lowland rice areas, where the soil is soft and wet throughout the year, as in parts of Burma and Malaya, cultivation is reduced to the slashing of the grasses and weeds which make a dense cover of the land during the fallow season, permitting them to rot for some weeks and then clearing the rotted material off the land immediately before transplanting the seedlings.

In other small areas, the traditional cultivation consists merely in driving water buffaloes round and round the fields. This gives an effective puddling of the soil, in which seedlings are then planted.

Where an annual inundation of the lands is a fairly regular occurrence, special varieties of rice, known as floating varieties, are broadcast on dry or moist soil or transplanted from nurseries in time to permit the plants to become well established before the fields become flooded. As the waters rise these plants grow rapidly and their elongated stems keep the leaves floating on the surface of the water. Sometimes these rices have to be harvested from boats and when conditions are good heavy crops are reaped. Floating rices are grown in parts of Burma and Bengal and, on a large scale, in the central plains of Thailand.

The seed-bed.—The nursery plots for lowland transplanted rice are always well prepared so as to produce a quick growth of robust seedlings for transplanting. Whenever available, local fertilisers are evenly incorporated in the seed-bed during its preparation.

These fertilisers consist chiefly of wood ashes, locally made bone meal, dry powdered dung, bat guano, burnt earth or other similar materials. In some countries, dried human manure is used, while in others artificial fertilisers are applied. The seed is usually soaked in water for three days to initiate germination; it is then broadcast evenly on the seed-bed and covered lightly with soil. If rains are not timely, the nursery is watered daily to ensure even and regular growth and the seedlings reach their optimum size for transplanting after 50 to 60 days. The advantage of transplanting over broadcasting is to be found in increased crops and more effective weed control.

Transplanting.—The arduous work of transplanting seedlings from the seed - beds into the well - prepared muddy fields is almost invariably done by women. The men lift the seedlings from the watered seed-bed, prune them and pass them in handy bunches to the women, who become very expert in the art of planting out the seedlings rapidly and uniformly in the fields. Mostly such planting is done by hand, but in some areas, such as Indonesia and Malaya, frequent use is made of a simple implement known in the local vernacular as a ' goat's hoof '—an iron rod about 15 in. long terminating in two short prongs. This tool makes the work less arduous and assists in forcing the roots of the seedlings well down into the muddy bed of the field.

The spacing of plants in the fields depends mainly on the nature of the soil: in rich soils the spacing may be as much as 15 to 18 in.; in medium soils 10 to 12 in.; whilst in poor soils 8 to 10 in. is common. In wet rice cultivation weeding is invariably practised.

In rich soils, where growth is good and rapid and the plants form a quick cover, one thorough weeding, some six or eight weeks after planting, may be sufficient; sometimes a second weeding may be given and even a third, but much depends on the disposition of the cultivators.

Tillering usually starts about a month after transplanting. Self-pollination is usual, but there is also some cross-pollination between the plants, especially in cloudy weather.

Harvesting.—The reaping of the ripe crop is mainly accomplished by using a short saw-edged sickle in the large areas. In small areas, where rains and winds are liable to damage the standing

(Above) *Australia—mechanical harvesting using a machine with a 12-ft. fore-cut which has been adapted from a wheel-type wheat auto-header and can enter a crop without damage in opening up*

(Left) *In many countries of Asia harvesting is still done by hand*

crop, small specialised knives may be used to cut each ear of ripe grain separately, as in Malaya, where the 'tuai' is in frequent use. After harvesting, the grain is dried and threshed by simple, age-old methods. These include threshing by rolling the ears repeatedly with the feet, by beating the bundles of long-stalked ears on a short ladder placed within a large open tong, or by driving cattle continuously over heaps of cut ears.

Winnowing.—Similarly, winnowing is a simple process in most countries. Full use is made of the breeze, by causing the grain to drop through shaken hanging sieves, when the dust and chaff are blown away and the good heavy grain is collected below on mats.

For small lots dexterous hand movements effectively separate light grains, husks and dust from good grain, when the mixture is tossed deftly on oval trays, as in India and Malaya. In China winnowing is mainly performed by passing the dry grain through a wooden box, in which it is subjected to a wind caused by a rapidly rotating hand-powered fan—a simple but effective apparatus that has been in use for centuries.

Milling.—Most of the small producers in the Far East aim at retaining 12 months' supply of grain to provide for their own family needs, and this is stored as unhusked rice, generally called 'paddy'. Daily or periodically, small amounts are milled as required, this work being performed almost entirely by women. The simplest type of mill is a form of pestle and mortar made in hardwood and designed to take about 20 lb. of paddy at a time. Sometimes they may be much larger and operated by two or three women. Often they are designed to be operated by foot or water power by simple mechanical arrangements.

Rice mills are of various types and sizes: the larger mills may have a capacity of 200 to 500, or even 1,000 tons of paddy a day, and the small mill may be able to deal with 10 to 75 tons a day. Whereas the former are usually situated at or near ports or in the centre of large paddy-producing areas, and are concerned with the production of rice for the export trade, the latter are usually found scattered around producing areas, and mill paddy for local consumption.

The process in both large and small mills is essentially the same, although the production of rice for the export trade necessarily calls for greater care in the grading of the paddy, and in variations in milling—and particularly in the degree of milling and the proportion of broken grain in the finished rice—to conform with the requirements of importing countries than does the production of rice for local consumption. For the production of high-grade rice, the paddy passes through five processes in the mill, *viz.* cleaning, hulling — also known as shelling, pearling, polishing, and grading.

Yields

Yields are very variable, since the conditions under which the crop is grown vary greatly.

They range from 5 cwt. per acre in the East to 80 cwt. in Italy and Spain, where it is customary to use quantities of fertilisers and where

India — An old-type foot-operated threshing machine, manufactured in Japan

Photo: FAO

water control is good. In South-East Asia the best crops—40 to 50 cwt.—are recorded in Japan and in parts of South China, where manures are used. In large areas of Thailand and Burma crops vary around 25 to 30 cwt. per acre, but the overall averages would be nearer 12 to 18 cwt.

In many rice-producing countries average crops are low, as would be expected when water supplies are often precarious, tillage animals inadequate and where little fertiliser can be used. Efforts are in train in most producing territories to improve crop averages, but the process is slow because of the vast areas, lack of trained technicians, lack of capital and incentive, smallness of holdings etc.

Improvement in production

The usual means to improve crops include more drainage and irrigation schemes, selection of the best varieties to suit each area, more thorough cultivation, greater use of fertilisers and green manures, better control of pests, better marketing facilities, subsidies for clearing new areas, the use of weed-killers and rotation crops, better supplies of draught animals, mechanical cultivation and better schemes of settlement of farmers on new areas.

At the FAO Conference in Baguio in 1948 it was established that as much as 10% of the crop in South-East Asia was lost annually through pests and diseases in the field. This loss would approximate some 10 million tons annually. In some small locations pests may often destroy 50% of the crop, because control measures are not applied.

Similarly, in the milling, storage, transportation and handling of rice it is claimed that losses of up to 10% are possible. This is mainly due to rats, weevils, damp, pilferage etc. Steps have been taken in many mills and stores to reduce such losses. As a result longer storage is practicable and the grain is comparatively free of the worst pests.

Mechanisation

In Australia and the U.S.A., the production of rice is completely mechanised with highly successful results, since in those territories land holdings are large, water supplies are well controlled, capital and machine experience is plentiful and there are no hampering social or traditional factors. In most of the South-East Asia region, experiments in mechanisation, continued over several years, have indicated that good tillage can be accomplished by men of practical experience, provided that there is a good measure of water control, but that social, economic and traditional factors render mechanisation extremely difficult in general application.

The small size of the holdings and of the fields in these holdings, the lack of mechanical knowledge and experience, the lack of capital (some £50 per acre in Australia) and the absence of co-operative organisations, together with inadequate irrigation and drainage in many areas and other adverse factors greatly retard progress in the mechanised production of rice. Where water control is reasonably satisfactory there would appear to be some prospects for private contractors or public companies supplying machines and skilled operators to undertake work in suitable contiguous holdings in parts of South-East Asia. Some experts maintain that the best chances of overcoming these difficulties would arise through the gradual education of rice growers through improved implements akin to those now in use or small types of mechanised equipment.

Quality and health

At the FAO Rice Conference in Baguio the poor quality of rice, from the viewpoint of health, was much stressed and many suggestions for improvement were made. These included the encouragement of the consumption of under-milled rice; the perfecting of the process of parboiling, which has good prospects; the use of enriched rice, and a general improvement in the diet of rice eaters. It was pointed out that, whatever rice was eaten, it formed too large an item in the diet, which was usually deficient in calcium, fats, vitamins and proteins, and it was urged that the diet should include more milk, meat, fish, eggs, green vegetables etc. Much thought has been given to all these dietetic problems and, though the remedies are fairly well known, there are practical difficulties, and hence progress is slow and is inseparably linked with the economic status of rice consumers.

World trade

According to the FAO Rice Commodity Report of November 1956, only about 4% of the world production of rice enters into foreign trade. The main exporting countries were Burma, Thailand, North America, Italy and Egypt and their aggregate export in 1954 was approximately 2.5 million tons of milled rice.

The chief importing countries were Japan, Indonesia, Ceylon, India, Cuba, Hong Kong, Malaya, France, Germany, Holland and the U.K. Their aggregate imports amounted to over two million tons, of which Japan, in spite of its high productivity, accounted for one million tons.

Photo: Shell

Philippines—treating rice seedlings with a solution of Shell Endrin 19.5% E.C. to guard against attack by the rice stem borer

Summary

Although rice is a very old and very important crop, its improvement still provides many interesting and necessary problems in the field, in the stores, in the mills, in transportation and in designing suitable diets. The rapid rate of increase of rice-eating populations in the East and the increased cost of rice forcibly indicate that areas of rice must be expanded and that increased use must be made of rice substitutes, where these can be produced or purchased economically.

Fighting Forest Fires from the Air

(Below) *Coming in low at 100 m.p.h., a 'Beaver' about to jettison its load of 200 gal. of water*

Roaring in at 150 m.p.h. trailing a moving curtain of hard-driven 'rain', some 2 chains long and from 15-20 ft. wide

A NEW weapon in the constant war against forest and grassland fires is already showing great promise in a series of dramatic experiments now being conducted in New Zealand under the auspices of the Soil Conservation and Rivers Control Council.

These experiments have shown that six light aircraft of the type in regular use for aerial farming can deliver the equivalent of 1 cu. ft. of water every second. This is about what a modern city fire engine linked to a high-pressure main can do, but the aircraft can operate from water sources at landing strips up to five miles away from the fire. Within seconds—minutes at the longest—they can reach and attack a blaze that fire-fighters on the ground might not be able to reach at all, or only after a long hard struggle and then with strictly limited fighting resources.

Early trials

In the first tests, at Wellington City Airport, Rongotai, last October, water jettisoned from a Tiger Moth provided a pattern of distribution which effectively extinguished a simulated grass fire created by burning straw.

Several flights at heights varying from 15–50 ft. were made across two rows of rain gauges placed 5 ft. apart. The effect of the slipstream was such that the water fell at an angle like driving rain, and the gauges were not wholly satisfactory, but they did confirm a distribution pattern of thorough saturation over a strip 20 ft. wide and 200 ft. long.

Straw was then spread generously over an area 12 ft. wide and 20 yd. long and set alight. In successive trial flights across this zone the flames were replaced by steam in a 22-ft. strip at each flight and the fire was put out except where there were dense heaps of straw. These rekindled slowly, suggesting that further applications would have completely extinguished the fire.

For a second test carried out at Rotorua the fertiliser hoppers of three Beaver aircraft were adapted for rapid jettisoning of water. Each hopper held 200 gal. A fire zone 50 yd. long and 12 yd. wide was created by setting alight heaps of baled hay and light branches, the whole saturated with diesel fuel to produce a fiercely blazing mass.

The first flight made at 40 ft. completely doused the flames and, except along one edge, replaced them with a cloud of steam. One minute later the second flight extinguished this blazing edge, and the third flight served to put out reviving flames created by embers on the logs and the diesel fuel.

In another test the jettisoning of 200 gal. of water from heights of from 20–50 ft. within two or three seconds produced an advancing curtain of water, most of which spread into large rain drops and fell in a swathe of from 22–33 ft. wide, according to the height of release. At the lowest height, solid 'bolts' of water remained undissipated and struck with enough force to scour holes 4 in. deep in the sand, or to overturn rain gauges set in the ground.

An aircraft flying at 100 m.p.h. spread water over an area approximately one-third of a chain wide and two chains long. The heaviest application was, naturally, in the centre of the swathe, but the overall rate was equivalent to 0.15 in. of rain.

Further tests planned

In the near future it is hoped to test the efficiency of aerial attack on 'slash' fires in cut-over forest areas and on genuine rather than simulated conflagrations in native grass or tussock, growing in the Canterbury area.

New Zealand has some 14 million acres of mountainous country in which a dense cover of native tussock is a vital protection against flood and erosion problems; at the same time, it is a fire hazard of great magnitude. On much of this steep rough land, far distant from adequate fire-fighting water supplies, conventional methods of beating a blaze are almost useless. 'Bombing' with water from the air may well be a quick answer.

Although senior officers of the State Forest Service are taking a cautious view about the possibilities of using the air arm to control major forest conflagrations—pointing to the gigantic magnitude of a forest on fire, and to the perhaps disastrous turbulence in the air above such a blaze—aircraft, linked by radio with fire sentries in forest watchtowers and with other spotter aircraft, offer undreamt of speed in getting early and effective action at the scene of an outbreak in remote and inaccessible areas.

THE NATURAL RUBBER INDUSTRY

This report, of which a brief abstract is given, will be of great value to all engaged in this important industry; some of the findings have a wider application to the work of other crop research organisations located in remote places.*

AT the end of the war an entirely new position had to be faced. The demand for rubber had become so great that there was no prospect of meeting it with natural rubber alone. It was clear that the gap could only be filled by the continued production of synthetic rubber in the plants that had been erected during the war in the U.S.A. It was also apparent that synthetic rubbers of the GR-S type could not simply be regarded as ineffective substitutes, likely to be eliminated as soon as sufficient natural rubber was again available.

Today, 12 years later, the worth of commercially-produced synthetic rubbers is fully established. Rapid advances are also being made in the development of plastic materials and these in turn are being combined with synthetic rubbers. These achievements have largely been made by branches of the chemical industry, which are powerful and highly competitive. If this competition is to be met by natural rubber, it is imperative in the first place that the price of natural rubber should be low enough to ensure that it will be preferred to the alternative synthetic products; secondly, the supplies reaching the manufacturer should be of a form and quality which will meet their requirements; thirdly, every effort should be made to exploit to the full the properties of natural rubber; and, fourthly, efforts should be intensified to rectify as far as possible its known shortcomings.

Clearly, cost will in the main be determined by effective management and methods, both in the field and in subsequent processing. The factors which result in the maximal production of rubber per acre at the lowest cost must be carefully analysed. The reasons for the variation in quality in the collected latex and the best procedures for processing can only be elucidated if the physico-chemical and biochemical properties of latex and the modifications induced by processing are known.

Prof. G. E. Blackman, Head of the Department of Agriculture, Oxford University, Director of the Agricultural Research Unit of Experimental Agronomy and Chairman of the Advisory Committee on Natural Rubber

It is considered incumbent on the plantation industry itself to sponsor basic research, even though the results in terms of financial gain may not be immediately apparent. New knowledge will generate new ideas for technical advances or improvements and the exploitation of these will often have to be protected by patents; these may often overlap some of the patents for the synthetic products. In consequence, if basic research on the properties or processing of natural rubber is neglected, technical progress could be hampered, or even blocked, by patents arising from the studies of synthetic rubbers.

The following is a very abbreviated version of the observations and recommendations of the Advisory Committee on the work of the Rubber Research Institute of Malaya.

Breeding and selection

A valuable contribution to the industry has been the production of the R.R.I.M. 500 and 600 series of clones. With these and others, productivity of rubber in terms of dry rubber per acre has been multiplied several fold.

* Report of the Advisory Committee enquiring into Production, Development and Consumption Research in the Natural Rubber Industry, price Straits $2.00 (approx. 5s.)

Photo: Dr. Paul Wycherley

Aerial view of the Rubber Research Institute of Malaya showing the library and the extensive laboratories. There is also a field station at Sungei Buloh, 15 miles away

Future development should place greater emphasis on controlled hybridisation to give seedling progenies, and the programme of selection should be intensified to explore the possibilities of the production of F.1 hybrids, a technique which has proved so valuable in other crops, such as hybrid maize and forest trees.

Modern techniques of vegetative reproduction, such as stooling or mist culture, should also be actively investigated with a view to the production of clonal rootstocks or self-rooted clonal material.

Assessment of field performance

Much information relating to the influence of tapping on girth increment has been collected, but no comparable information is available on how tapping procedure depresses the rate of gain in dry matter of the whole tree or any differential effects on the various parts of the tree. Nor is it known what is the influence of inherent constitution or nutritional or other environmental factors on the partition between the yield of latex and the total production of dry matter. It will be essential in field experiments to sacrifice many complete trees at intervals to determine total dry weight and carry out the other essential measurements.

Stimulation of latex production

A major contribution made by the Institute is in the study of high tapping and the development of growth regulators for the stimulation of latex production, in particular the employment of 2,4,5-T. There is need to assess the most promising of these growth compounds to discover, firstly, whether they are more effective than the materials which have so far been tried by the Institute and, secondly, to ascertain whether they can also be employed to increase the yield of latex from younger trees which are still making active growth. It is also of importance to gain some insight into the physiological mechanisms which control the increased flow of latex and to investigate further the interactions between the systems of tapping and the additional latex production induced by the application of the growth regulator.

Reappraisal of existing field experiments

It is not unreasonable to query the scientific value of comparisons between families of illegitimate seedlings, inasmuch as each family has a unique composition of individuals and the experiments as such are not reproducible. Again, no true elucidation of the relationship between stock and scion can be achieved if the rootstocks consist of illegitimate seedlings. The experiments should be critically examined and only those of really scientific merit continued. *This important recommendation applies not only to the selection work, but also to the field trials on nutrient requirements.*

It is of great importance to assess the economic usefulness of cover crops and to determine which crops, if any, or which mixtures of covers give the best results.

Pathological division

The illustrated manual, now in preparation, describing the diseases of the rubber tree should be very helpful to the plantation industry in aiding accurate identification. It is apparent that the importance of root diseases, particularly in replanting, is fully appreciated and a part of the programme should be devoted to defining which procedures will lead to minimal losses.

Soils division

The pot culture investigations relating to the determination and elucidation of the symptoms due to deficiencies of micro-nutrients have made such satisfactory progress that surveys should be undertaken to appraise the economic significance of individual micro-nutrients in actual plantation practice.

In experiments on the nutrition of the rubber tree the employment of radioactive isotopes may seem attractive. Some limited problems could be elucidated by simple means and inexpensive equipment which should give relatively trouble-free service under tropical conditions without special servicing.

Lalang (*Imperata* spp.) and other grasses are serious pests of rubber. Many new materials for weed control are constantly being offered for test, but only a small proportion prove to be worthy of extended trial. Attention should be restricted to those compounds which have been found to be of value by research organisations specialising in the assessment of herbicides.

Establishment of sub-stations

There is a provision for the establishment of three sub-stations. Regional sub-stations are essential to amplify and consolidate the results obtained at the field research station at Sungei Buloh and should be sited to meet the regional needs of the plantation industry.

They should be large enough to allow *complete* experiments to be undertaken, both in relation to the adequate testing at each sub-station of the most promising selections or of major manurial requirements.

Chemical division

In the studies concerned with either fresh or processed latex the general approach seems to be on sound lines and new information is being accumulated. Research on the non-rubber constituents, which is being carried out in conjunction with the British Rubber Producers' Research Association, should ultimately lead to a better understanding of the basic principles underlying technological and manufacturing processes.

An initially purely scientific enquiry into the properties of a mixture of vulcanised and unvulcanised latex has led to the development of a new and promising material, namely, superior processing rubber. The further exploration of oil-extended natural rubber seems desirable.

For the technical control of the production of technically classified rubber at plantation factories, the industry should set up an independent centre to carry out the necessary tests.

Advisory services

The first principles for the successful organisation of a research institute is that the research worker should be subjected to the minimum of administrative duties and paper work. Central administration should be such that little administrative work falls on to the heads of divisions, whether by way of inter-departmental memoranda or the too frequent preparation of reports. *Active research workers should be relieved from having to spend much time on the day-to-day routine advisory work, but should be consulted only about special problems.*

In view of the large proportion of the total rubber production which is now in the hands of the smallholders,

(*continued on page* 494)

THE TERMITE

Part II.—Its Depredations and its Benefactions

W. WILKINSON

(*Termite Research Unit, Port Harcourt, Nigeria*)

AFTER thinking a little about what a termite is and where and how it lives, the question which naturally follows is, 'How does it affect Man?' Considered in the usual light as a destroyer, it does so basically by competing with him for cellulose, which Man wishes to conserve in one form or another. In general, the termite is a serious nuisance only in those places where it is prevented from feeding normally. This is effected by the removal of its natural food sources in the way of fallen timber and vegetable debris and the substitution of cultivated plants and tree crops, conserved forests and wood derivatives, such as timber and paper, all of which offer an acceptable alternative diet.

Although termites do extensive damage to timber work and can be very destructive to living plants and trees, they can also be beneficial to the soil.

Damage to timber

The most obvious damage is caused to buildings and other structures, and in the worst affected areas the cost of repairs and replacements can be very high indeed. Accurate estimates are, of course, difficult, but, to give one example, the British West African territories have reckoned that termites have cost them £250,000 in repairs to major public and commercial buildings alone, during 1954.

Preventive measures

Subterranean termites can virtually be excluded from a building if a suitable barrier is incorporated. The Drywood family are a more difficult problem, as the winged ones infest a piece of timber direct, and do not require a subterranean base from which to operate. It is necessary to use one of the few naturally resistant woods or, even better and more practical, chemically-treated softwoods. There are bound to be difficulties in this treatment, but with care and ingenuity it is possible to obtain reasonable protection.

Some countries, realising the economic importance of preventive measures, have established research centres and encouraged the use of pressure-impregnation plant for timber. Since the war, South Africa has realistically tackled its fight against the Jamaican *Cryptotermes brevis* by controlling timber movement and usage, and standardising protective treatment.

Damage to living plants

Damage to standing crops is a less widely recognised aspect of termite depredations, but of no less primary importance to the growers concerned. Mutilation of living trees varies greatly both in the species concerned and the mode of attack. It is most in evidence in Australia and Central America. Tunnelling may extend into the heartwood, or may be concentrated there, turning an apparently sound tree into an earth-filled pipe. Tree seedlings are not immune and a heavy casualty rate may occur, particularly in marginal

Damage to dead wood—an apparently sound piece of plywood, with the top veneer stripped off, exposing galleries of Cryptotermes havilandi, *some packed with the hard, oval faecal pellets characteristic of the* Kalotermitidae

areas where plantations of introduced species are laid out. An example of this is seen in the growing of *Eucalyptus* in parts of Africa, where ring-barking or complete felling of newly transplanted young trees commonly occurs.

The boring into and partial eating of trees and bushes frequently reduces the crop, even if the plant itself is not killed. Thus cacao in West Africa can be the victim of *Neotermes aburiensis*, one of the Kalotermitidae. It begins the colony, like its congeners, in a dead branch or snag, but then moves on into the living wood. Tea, citrus and sugarcane are but three of those preyed upon and cotton is subject to attack from below by a number of species. The harvester termites, mostly *Hodotermes* and *Trinervitermes*, live under normal conditions by cutting grass or herbs into small pieces to take back to the nest. Quite naturally they turn to cereal and other crops planted in their territory. It would be easy enough to extend these few examples into a long catalogue of spoliation. The marvel, however, is not how much of man's produce they destroy, but how little, considering they exist in such astronomical hordes.

Termites as soil improvers

The actual number of species with a direct adverse effect on man is, in fact, small compared with the remainder. Quick to note their obvious bad points, we do not look so closely at the benefits termites may confer. They probably influence aeration of the soil and are undoubtedly a major factor in the clearance of dead vegetation. Those which dwell near the surface will assist in the turnover to humus, particularly in forest regions.

Others live too far underground for the broken-down debris to be returned quickly to circulation, but, if they build mounds, they bring subsoil to the surface. This can be an advantage to some mineral-deficient topsoils. Throughout large tracts, the greater part of the termite population is humus-feeding, passing soil through the gut, rather after the manner of an earthworm. Parts of upland Kenya are densely pimpled with their low, rounded mounds, built only a few feet apart. The likelihood of their altering the constitution of the soil when in such a concentration has inspired a research project, now being completed.

Mounds can be so rock hard as to provide a good road-making material. The soil of the big *Macrotermes* and *Odontotermes* mounds seems to bind better than the surrounding earth and is used for constructing mud huts and hard tennis courts.

Damage to living wood — typical 'piping' of a grapefruit tree, Citrus paradisi, *by* Coptotermes sjostedti *at Port Harcourt, Nigeria*

Need for more research

As the originator of a social system analogous to, and in some ways more developed than, our own, the termite deserves respect and further study. Leaving aside any philosophical aspect, however, further research into the group is necessary if progress is to be made in controlling its relations with man. Unless one can recognise the identity of a species, and know exactly how it lives, how is it possible to counter at its weakest point?

The following four short papers of general interest are recommended for further reading:

Coaton, W. G. H.: 'Termites and their Control in Cultivated Areas in South Africa', *Bull. Dep. Agric. S. Afr.*, 1951, **305**, 1–28.

Harris, W. V.: 'Termites and Tropical Agriculture', *Trop. Agriculture*, 1954, **31**, 11–18.

Harris, W. V.: 'Termites and Forestry', *Emp. For. Rev.*, 1955, **34**, 1–7.

Hesse, P. R.: 'A Chemical and Physical Study of the Soils of Termite Mounds in East Africa', *J. Ecol.*, 1955, **43**, 449-461.

Natural Rubber

(*Continued from page* 492)

it is imperative that there should be no lack of instructors to carry out advisory work.

Liaison

One of the most serious problems which confronts research workers in the tropics is the difficulty of keeping abreast of scientific developments in other countries and there is a danger that research may be held up by a lack of knowledge of new techniques or sources of material. Equally, new investigations may be started which overlap or repeat previous investigations.

The world demand for first-class scientists has outstripped the supply: Many fields of knowledge have now become highly specialised and it may not be possible to appoint experts in certain fields of the Institute's activities. In many instances much could be achieved if experts could be invited to visit the Institute for short periods.

Particular importance is attached to the establishment of good connections with universities and other scientific institutions, since in the course of research at the Institute some small facet will require study which cannot be undertaken because the technique is too specialised or the equipment very expensive.

An International TD18 tractor drawing a McCormick International 10-ft. serrated disk harrow fitted with extra weights, which bring the total operating weight to nearly 5 tons and thus ensures deep tillage

TILLAGE IN SUGAR-CANE

O. MUELLER

(*Voltas Ltd., Bombay, India*)

Important factors which contribute to improved yields of sugar are the depth and quality of tillage. New techniques for the cultivation of heavy and light soils in India are here described.

SUGAR-CANE cultivators in India are now adopting more intensive methods of cultivation in order to obtain higher yields of cane. Among the factors contributing to an increase in production, the depth and the quality of tillage are of special importance.

The application of larger doses of fertiliser, without efficient tillage, is unscientific in concept, and also a waste of money and effort. It is more economical to spend a few extra rupees on proper tillage to the desired depth than to save a paltry sum through inefficient tillage.

Compact soils

The soil conditions in the Deccan are in general very difficult. Only with the heaviest tillage equipment is it possible to obtain a satisfactory degree of pulverisation. The tillage technique followed at present is, however, far from ideal.

Normally, the first operation in the preparation of a field for planting cane is deep ploughing. Deep ploughing, say to a depth of 14 in. in compact soil, will produce broken soil to a depth of 18–20 in. This initial operation is followed up by a number of harrowings, but the heaviest harrow will only be able to penetrate 8 or 9 in., with the result that only the top 8 or 9 in. will be pulverised, while the bottom layer cannot be reached to break the underlying big lumps.

Subsequently the cane is planted to a depth of 8–9 in., which means the cane cuttings are placed on top of big lumps. Under these conditions, the first feeder roots are bound to strike unpulverised soil, which is far from being an ideal condition for root development.

Extensive trials carried out under these particular soil conditions have shown that it is possible to obtain complete pulverisation of the seedbed by adopting a different technique, which is in many cases cheaper than the old technique.

In this new method, the field is first harrowed by means of a deep tillage harrow fitted with extra weights to effect penetration in hard soils. This pulverises the soil to a depth of 8 in. Subsequently the field is ploughed by means of a heavy-duty disk plough, which buries the pulverised topsoil and brings the unbroken soil to the top. The same deep tillage harrow, but now without weights, can then be used to pulverise the unbroken lumps on top. It is thus possible to achieve practically complete pulverisation of the active layers of the soil and prepare a seedbed ideal in every respect.

This type of tillage has only become possible through the introduction of the deep tillage harrow; the harrows now being used have neither adequate clearance nor weight to penetrate to the required depth.

In general, it is possible to do two harrowing operations for the cost of one ploughing operation. Furthermore, the cost of ploughing after harrowing is also much less than the cost of ploughing an unharrowed field. The cost is therefore likely to be less than by the conventional method.

The following tillage techniques are recommended:

(*a*) *Food crops or green manure followed by cane.*—This entails the following operations: (i) one operation with deep tillage harrow fitted with maximum amount of extra weights; (ii) one ploughing with heavy disk plough; and (iii) one operation with deep tillage harrow without extra weights.

In soil which is difficult to pulverise it may be necessary to carry out two operations, each with a deep tillage harrow, both before and after ploughing.

(*b*) *Cane to be followed by food crop or green manure.*—This requires one or two operations with the deep tillage harrow fitted with extra weights. The deep tillage harrow also makes it possible to incorporate cane trash into the soil. For the successful chopping and mixing of this trash, the soil as well as the cane trash should be as dry as possible.

(*c*) *Cane followed by cane.*—One or two operations with deep tillage harrow, fitted with extra weights, followed by one ploughing with heavy-duty disk plough, and one harrowing with deep tillage harrow without the extra weights.

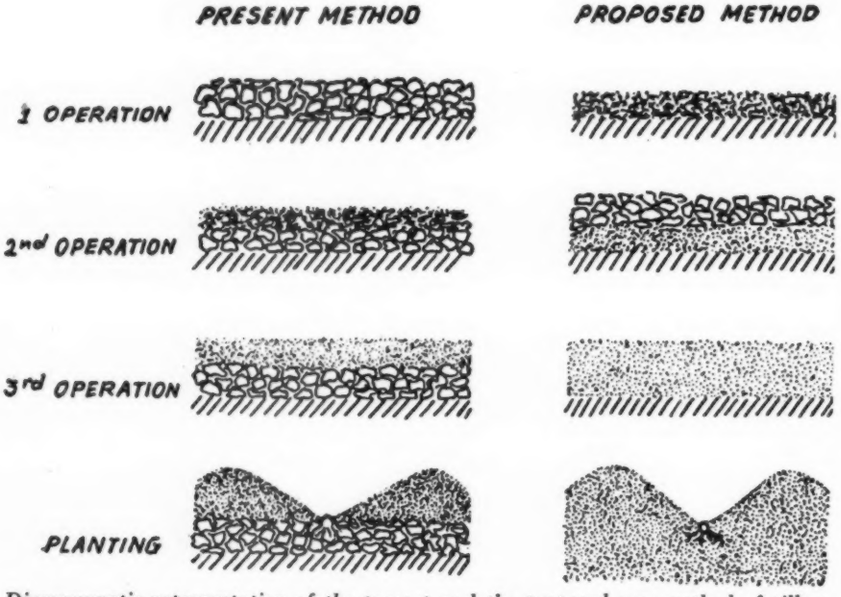
Lighter soils

In general, a similar technique can be adopted in Northern India as in the Deccan, except that here it is possible to use lighter implements. In most cases a heavy horsepower wheel tractor will be able to do the work efficiently. However, the same problem of pulverising the soil at the lower level does exist in the north, even though the soil is not so hard.

(*a*) *Food crops or green manure followed by cane.*—Operations are required in the following order: (i) one or two operations with a heavy offset harrow; (ii) one operation with a heavy disk plough; and (iii) one operation with a heavy offset disk harrow.

(*b*) *Cane to be followed by food crop or green manure.*—A heavy offset harrow may be used once or twice to chop up and incorporate the cane trash.

(*c*) *Cane followed by cane.*—In this case two operations with a heavy offset harrow, followed by one operation with a disk plough and subsequently one operation with a heavy offset harrow, will produce perfect soil conditions.



Diagrammatic representation of the present and the proposed new method of tillage of the sugar-cane soils of the Deccan in South India

Drier conditions

Tillage as described above would cause, in the case of land which is insufficiently irrigated or is unirrigated, the drying out of soil moisture, which it is essential to preserve if cane cultivation under these conditions is to be successful.

By means of an offset disk harrow a very fine disking needs to be done in one or two operations. If trash is available, it can be chopped and mixed with the top soil. It is important that this disking is done as soon as possible to prevent the soil from drying out, even if it is not possible to do the other operations immediately.

If very fine disking has been obtained, a heavy chisel cultivator should be used several times to obtain a fine tilth of lower layers of the cultivated area without losing any moisture.

Any fertiliser, groundnut cake or even compost added to the soil should be dropped behind the chisels to lower layers of cultivated soil where adequate moisture is available to enable the roots to absorb these nutrients.

Abstracted from an article appearing in the *Statesman* (India), 29 May, 1957.

Xth International Cocoa Conference

A three-day international cocoa conference was held in London in September, which was chiefly concerned with the exchange of scientific information on the cultivation and processing of cocoa. Papers were contributed from Malaya, Fiji, Trinidad, Ghana, Nigeria, Jamaica, Ivory Coast, New Guinea, Belgian Congo and Latin America.

Of particular interest were the contributions made by representatives of the Belgian Congo regarding the application of fertilisers and on light and shade techniques in the cultivation of cacao. Papers were contributed on the control of black pod, capsid and swollen shoot disease. Though much progress has been made in pest and disease control, theory is too often ahead of practice. Swollen shoot virus continues to provide problems for research and new work is being done on vector control and coppicing.

Since the known areas of the world with optimum soil and climatic conditions for cocoa are limited, the conference laid particular stress on the need for further soil surveys.

Flax growing is a leading industry in the Soviet Union. Here a machine is pulling the flax on a collective farm in the Gorky region

RUSSIA TODAY

Agriculture in the Soviet Union

W. G. CASS

Following the serious situation in 1953, *the output of agricultural machinery and fertilisers was speeded up; in* 1954, *there was a drive to extend the area under grain; in* 1955, *there was a call for the increased production of all crops* (WORLD CROPS, 1956, **8**, 314) *with the result that* 1956 *appears to have been a good year for agriculture in Russia* (WORLD CROPS, 1957, **9**, 300).

The present report suggests that the blight of bureaucratic control was the main reason for the very serious difficulties of nationalised industry in the past and it gives a clear warning to those engaged in economic planning not to overlook the human factor.

DESPITE the enormous amount of material written and spoken, and published in innumerable Soviet books and journals, about the state of agriculture in that vast territory, it is not easy to obtain a true and balanced picture. Reports are contradictory: laudatory statements about achievements are so often offset by denunciations of failure and inefficiency. Very few important absolute figures are given; percentages and multiples—so many times larger or smaller—there are in plenty. Possibly the contradictions are not really significant: they may merely indicate that standards of efficiency and achievement vary considerably in different regions in this huge land area.

Krushchev himself, on a recent visit to Kalinovka, in East Ukraine, had something to say on this subject. Kalinovka and other farms, he said, belonged to the advanced category; but there were others which were backward. Conditions were the same, the land was the same, but results differed. Why? Then he added: it was because the District Committee did not consider and deal with each farm individually, as it should do. Guidance on general lines was out of date.

Increasing demand

Without quibbling over a possible inconsistency between this statement and the earlier one about land and conditions being everywhere the same, it is more important to note some of the reasons why Soviet agriculture has not been keeping pace with the requirements of the national economy. The two main reasons* were—increase in population, and a higher standard of living. This latter comprises, of course, not only food, but also textiles and other products, produced from agricultural raw materials.

The population has increased from 159,200,000 in 1913 to 200,200,000 in 1956. In 1913, over four-fifths (82.4%) of the population was rural; in 1956, it was only a little more than half (56.6%). As regards higher living standards, figures issued by the Central Statistical Board show that, in 1956, purchases of footwear and textiles in many parts were doubled or even trebled; and the consumption of foodstuffs showed an increase of 62% for meat and fats, 86% for eggs, 87% for sugar, and the consumption of milk and milk products by clerical and industrial workers had doubled, as compared with 1940.

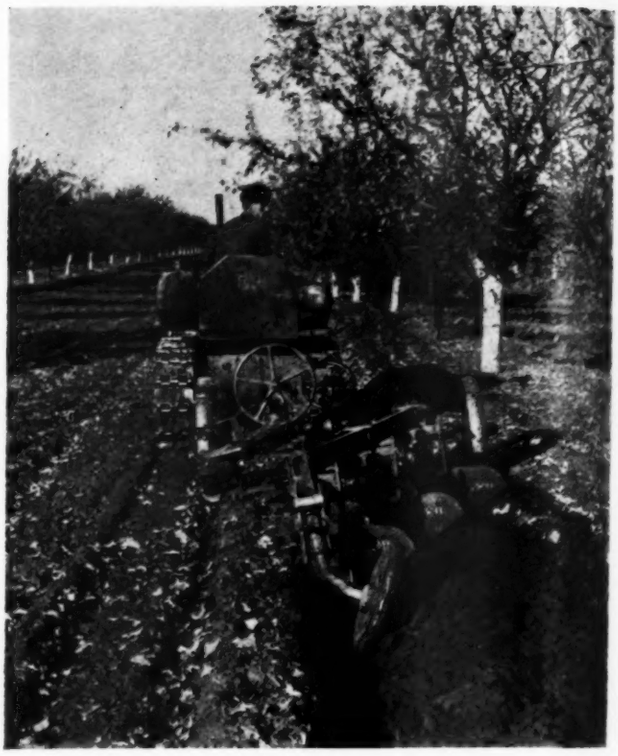
Mistakes and shortcomings

Apart from this increase in demand, it has to be admitted that in technology, in organisation and in policy, Soviet agriculture has suffered in the

* Other countries have succeeded, on the basis of private enterprise, in meeting these increasing demands.—ED.

past—and indeed still suffers—from serious mistakes. By way of example may be mentioned the haphazard fulfilment of specified or planned deliveries of grain and other produce. Weak or backward collective farms, which failed to come up to the required level, have been helped by the district leaders to reach, in some way or other, 'an honourable place and report successes'. Leaders at all levels (regional, territorial and state or republic) adopted some such policy, the net result of which was to force all collective farms and individual farmers down to the level of the least efficient. Material interest or incentive to high output was largely destroyed through what appears to be a peculiarly vicious form of bureaucracy.

Another example is the strange persistence of manual methods in various agricultural operations, despite the frequently boosted mechanisation of Soviet agriculture; it is now admitted that Soviet Russia is behind the U.S.A. in this respect (*vide* Khankovskii in *Novy Mir*, 12, 1956). The main trouble is that mechanisation needs to be co-ordinated and complete. If there is a weak link where the ancient manual methods are still used it upsets the cycle of operations and largely nullifies the benefits of machinery. At least, that is Khankovskii's view, and he explains it by reference to what are called post-reaping operations. Combine-harvesters are all very well, he says, and their use may reach 85% or even 100% of total harvesting in some regions of the south, but the subsequent operations of cleaning, drying, loading and unloading the grain, are still largely being done by hand, and often in very primitive fashion.



Mechanisation of a tree crop. Row-ploughing in an orchard of a State farm in the Kursk region

Blight of bureaucracy

Excessive bureaucracy and state interference are now generally condemned, including Stalin's policy in this direction, *and is now seen to be a major factor in discouraging enterprise and initiative*. Indeed, as late as 1955, such over-planning and centralisation was still too much in evidence, despite attempts, then in progress, to reduce officialdom. Incidentally, Stalin is now also censured for insufficient encouragement of electrification on the farm, so strongly advocated by Lenin, many years ago.

These and other shortcomings are at last fully recognised, and strenuous attempts are being made to improve the position, although even now, the blight of bureaucracy strangely persists in a country where one would have thought a definitely determined State policy could have been strictly, even ruthlessly, pursued.

Among the main features of the new planning policy, established about March 1955, were firstly, *greater freedom* for the collective farmers to make decisions for themselves on matters of cropping and stock-raising, and secondly, to establish as the criterion of good management the amount of saleable produce actually delivered to the State, instead of the total area sown or the number of stock maintained. The idea now is to encourage *greater individual interest and initiative*. And yet the great possibilities, so hopefully envisaged, are still not being realised for Khankovskii says:

> 'Sometimes it is the routine habits and low initiative of collective-farm leaders; in other cases there are still many different authorities above the collective farm management that like to interfere with their stereotyped official methods, nervous of anything really new or enterprising, and clinging desperately to the old bureaucratic ideas'.

New targets

So far as agriculture is concerned they are now trying hard to work out a clearer and more effective policy. The planned target, as shown in the latest figures, is certainly high. In February 1956, the total output per annum of grain of all kinds—though what this includes is not precisely clear—is to be raised, presumably during the next five or six years, to 177,000,000 tons. Capital investment in 1954–55 was 34,400 million roubles,* or 38% more than for the whole of the fourth 5-year plan (1946–50). During those same two years, 400,000 15 h.p. tractors, 228,000 trucks and lorries, 83,000 combines, and other equipment were provided. The machine and tractor service stations have now a greatly augmented staff of engineers. More than 120,000 of what are called agricultural specialists were attached to collective farms in 1954–56; and some 20,000 or more of 'city workers' were proposed as chairmen of collective farms. Prices of produce supplied to the State are said to have risen sharply, so that collective farm income in 1955 reached 75,600 million roubles (nearly £7,000 million sterling).

Some of the foregoing figures look impressive, but without further details are nearly meaningless. So also is the further statement that tax collection has been eased in favour of the collective farms. Among other things, we

* 11.2 roubles = £1 sterling (November 1957).

do not know how many collective farms there are, or the respective proportions of collective, State, and individual farms in the total. It is understood that a few individual farms are still left, but there is little definite information on this point.

It may be generally inferred, however, that despite the bureaucratic bogey, Soviet agriculture is now making good progress. Between 1953 and 1955, arable cultivation increased by nearly 29 million ha.,* mainly due, of course, to opening up virgin lands (25 million ha.) Cattle increased by over 4 million; pigs by 4.6 million; and sheep and goats by 6.7 million, during 1953–55. For 1955, as compared with 1954, grain output increased 22%, sunflower seed 95%, sugar-beet 54%, flax (with linseed for oil) 74%, and milk yields 31% (yields per cow 16%). In 1956, the total area sown to all crops is estimated to be 194 million ha., *i.e.* an increase in about three years of nearly 37 million ha., and comprising chiefly, grain (wheat 14 million ha. and maize 20 million ha.) *This increase is about equivalent to that of the whole preceding 40 years* (1913–53).

Soil cultivation methods are being improved and more fertiliser was used in 1956. At the same time, weather conditions are often appalling in some part or other of the vast areas involved; early and late frosts are particularly injurious, although every effort is being made to breed frost-resistant varieties, *e.g.* of maize, and thus also extend cultivation zones further northward, both for wheat and maize.

Despite weather difficulties, the 1956 *grain harvest is said to establish a record.* State deliveries to 5 November, 1956 were 52,700,000 tons, constituting, it seems, by far the greater part of agricultural produce supplied to the State. Presumably the rest of such produce is disposed of in other ways. *The State now has a large surplus of grain for trading, for the most part, with the satellite republics. The delivery of grain was actually some* 50% *or more greater than in the previous year or two, and is one of the highlights in Soviet agriculture.* There were almost similar increases in livestock produce. Milk production in State and collective farms rose by 4,000,000 tons, and by 1 November, 1956, 15,900,000 tons had been sold to the State. There was a 23% increase in animal fats, and a similar story is told about meat and eggs.

State farms

The State farm is now an important feature in Soviet rural economy. In 1954–5 nearly 600 of these were established, including 425 in virgin territory, under the jurisdiction of the Ministry of State Farms, which now controls 23,000,000 ha. for grain alone. The latest Communist Party directives stipulate for delivery from these farms of nearly 15,000,000 tons of grain per annum by the end of the current 5-year period (1960). Under the rule of the same Ministry are also 340 specialised farms, of which 135 are for vegetables (including potatoes). During 1956–57, a further 100 of these farms of large size are to be established. Many of them are highly mechanised. But here, as elsewhere, labour efficiency and the degree of mechanisation varies considerably. Measured in terms of man-hours for different products, it requires from 1 to 3.6 man-hours per centner* of grain, 8 to 16 man-hours per centner of milk. The average yield of grain on these farms is over 20 centners/ha. It is anticipated that eventually the State farms will provide most of the grain needed for home consumption. With the inclusion of new or virgin areas the grain-growing regions of the Union spread far and wide, being no longer limited to favoured areas in the west and south.

Harvesting problems

Despite everything, harvesting losses are still serious, and the fault is not entirely climatic. For many years, great faith has been placed in mechanisation, using the combine-harvester, but seemingly this faith has lately been shaken; it is even now asserted that the combine system was causing (rather than preventing) losses of the order of 16 million tons of grain.

As an example, reference is made to the experience of the Budenny collective farm in the Krasnodar territory, on the Black Sea, where about 21 centners/ha. were harvested by the two-stage system. When perfectly ripe grain was harvested in one stage by combine, only 14.2 centners/ha. were gathered. It was concluded from this that the combine-harvester is not always the answer to harvesting difficulties, and that the single-stage system may sometimes, according to nature of crop and other factors, have to give way to the two-stage system. Moreover, even with the combine-harvester, harvesting is often unduly prolonged, up to 40 or more days, with losses accumulating all the time and amounting to one-half or three-quarters of the entire crop. In some parts of the Soviet Union, these losses are aggravated by hot, dry winds which scatter the grain from the standing, over-ripe ears.

* Hectare = 2.47 acres.

* Centner = 100–120 lb. (Germany).

Preparing the ground for wheat. Here an S-80 tractor is ploughing and harrowing in one operation on a State farm in the Novosibirsk region

Maize being harvested with a KU-2 combine on the Malenkov Collective Farm in Krasnodar Territory

Greater independence

Kalinovka (Ukraine) has a collective farm, a visit to which was described sometime ago in *Pravda*. Comparative figures of output for 1953 and 1956 strikingly exemplify at least one successful case of application of new methods, including an increase in grain crop yield from 7.4 to 30.1 centner/ha. (presumably the average for all grain crops). Milk produced per cow showed a remarkable increase from 1,164 to 3,726 kilos, silage from 120 to 4,500 tons, vetch-oats for hay from 28 to 531 tons, and so on. The flourishing state of the live-stock farming is attributed chiefly to maize. Hay is now being produced on land which would formerly have been left fallow. This custom dies hard, even though the district is well watered; it has now been found that as a result the yields in the next rotation are better than those obtained when the land had a period of fallow. In view of the increased yields of green fodder, maize, silage and vetch-oats hay now being obtained, it is hoped to raise the yield of milk still further from the previous high of 3,726 kilos to the target of 4,000 kilos, proposed by the agronomist, Vanin. *This general improvement is attributed largely to less official or state interference, and to freer play of initiative and enterprise.*

Incentives

The monetary income of this collective farm has increased during the past three years, from 687,000 to the astonishing figure of 5,600,000 roubles. Attempts are being made to reduce labour costs per unit of production. Rates of labour expenditure and payments in workdays are governed by what the most efficient workers can do. New methods of payment of the farm chairman, the agronomist, the veterinary surgeon, and the head foremen are being tried. They are credited with workdays on the basis of gross output. For example, the chairman is credited with 0.2 of a workday per ton of grain, 0.1 per ton of potatoes, and so on. Total workday credits for some of the leaders under the old and the new systems are:

	New rates 1956	*Old rates* 1948
Chairman	1,495	1,630
Veterinary specialist	1,030	1,304
Agronomist	1,442	1,467
Leader of No. 1 team	1,009	600

In 1955 it was decided to extend the area covered by the Kalinovka new farming policy, and delegates from other farms in the district were invited to a special conference to study the new methods and discuss the results. Already, some improvement is apparent. The poor milk yields of only 624 kilos in 1953, for example, have now been raised to 2,130 kilos; and the number of pigs fattened from 700 to nearly 10,000. In his visit to the district, already referred to, Comrade N. S. Khrushchev, expressed appreciation of the Kalinovka enterprise. This must rise to still higher levels and become a pattern for emulation throughout the whole of the Soviet Union, he said.

The writer is indebted to the Society for Cultural Relations with the U.S.S.R. for the loan of Soviet books and journals on which the foregoing account has been based. They have also supplied a generous selection of photographs.

Plastics in Agriculture

Two papers read at the International Corrosion Conference, recently held in London, are likely to be of interest to manufacturers of agricultural machinery and equipment, and agricultural chemicals: 'The Use of Vinyl Resins in the Construction of Chemical Plant', by W. E. Martin (BX Plastics Ltd.), and 'Sprayed Metal and Plastics Coatings', by G. H. Jenner (F. W. Berk & Co.). Summaries have appeared in *Corrosion Technology*, 1957, **10**, pp. 345 and 347.

NEW PUBLICATIONS

Climate and Economic Development in the Tropics

By D. H. K. Lee. Pp. 182. London: Oxford University Press. 1957. 28*s*.

It is difficult to summarise a book which is itself an epitome of present knowledge on the effects of tropical climate on agriculture, animal husbandry, human efficiency and industry. This book is the outcome of deliberations of a Study Group on Climate and Economic Development in the Tropics organised by the American Council on Foreign Relations. It is, in fact, more than the findings of the Study Group on which Dr. Lee was a prominent member, for on every page it bears the stamp of the author's personality, the convictions of a man with wide experience in tropical research.

The objectives of the Study Group were not only to present a statement of evidence concerning the effects of tropical climate, but also to indicate what further knowledge is necessary, how it may be obtained and what use can be made of it in order to secure better conditions for the inhabitants of undeveloped tropical countries.

It is shown that poor productivity and not a low purchasing power is primarily responsible for the inadequate diet of inhabitants in most tropical countries. The climate is responsible for poor soils producing plants with a shortage of specific nutrients, and particularly subject to pests, diseases and losses in storage. The widespread incidence of debilitating, incapacitating and life-shortening diseases seriously reduces both the desire to work and the efficiency of performance and these effects increase the likelihood of malnutrition and decrease the efficiency of preventive measures. Thus there is a vicious circle: disease—under-production—poverty—poor health services—more disease in countries where the people are afflicted by diseases which rob them of vitality and initiative and which create social lethargy.

Poor nutrition also constitutes a major cause of low animal productivity, thus linking it to poor crop production. Forage is low in minerals and protein content, while its high fibre content adds to the alimentary burden of the animal. Furthermore, the warm, humid climate puts a strain on the animal and greatly favours infectious diseases and parasitism.

Manufacturing production is generally at a low level, due not alone to climate, but to such factors as transportation, supply of raw materials, deterioration of materials, power supply and marketing difficulties. Labour is, however, usually the greatest hindrance: ' under-nourishment, disease, lack of education, lack of ambition, or ingrained custom, singly or in combination, may make of the apparent plentitude a veritable mirage '.

Although it is evident that climate has a depressing influence on tropical development, the author shows that non-climatic factors exercise equal, if not greater, effects upon the economic situation. Unsatisfactory systems of land tenure, social restraints, conservatism, ignorance, poverty, the sanctions of the social code and the desire for isolation all limit the progress of economic development.

The difficulties of the situation have been stressed, but the author has also much to say regarding the required action to effect improved conditions. He urges a more determined application of present knowledge and more research. In the present difficult transitional period the most highly qualified scientists, suited for this exacting work, should be recruited from the temperate zones. But ' rapid advances in tropical research cannot be expected until the tropical peoples themselves accept the responsibility, provide the means and acquire the competent personnel '. Dr Lee's final and personal conviction is that the problem of tropical development should be pursued with all speed and all possible support, but on a broad front in which climate, man, agriculture, industry and economics receive simultaneous consideration.

Research is the key to the future in the tropics; those engaged on research in the tropics and those who support this work should most certainly read this book, while administrators in tropical countries cannot afford to ignore this careful analysis on a subject which so profoundly affects the people they govern.

D. H. GRIST

Atomic Energy in Agriculture

By W. E. Dick. Pp. 150. London: Butterworth. 1957. 15*s*.

This is the fourth volume in the 'Atoms for Peace ' series and maintains the high standard set by the publishers in their very useful collection of works on atomic energy. The preface states that most of the material has been gleaned from the collected papers from the Geneva Conference of 1955. This might suggest nothing more than a rehash of highly scientific literature, but this is far from the case. Obviously with a thorough understanding of the material with which he is dealing, the author has sifted out the really important and salient features of an enormous mass of information and made them into a most readable and delightful book. As the editor, Mr. D. Wragge Morley, points out, Mr. Dick has worked in both the biological and the chemical fields and so is qualified to act as arbiter of what should or should not appear in a book of this kind.

The author has divided his subject matter into sections depending on the type of application of the isotopes. The use of radiations in producing mutations of use and interest to the agriculturist is his first theme. It is interesting that the Americans (who feared that, as generally thought, mutations could be only harmful) were not the pioneers in this field. The Swedes, with much foresight and bravery, took the risk and found that it paid handsome dividends. Much of the work mentioned in this section, then, is of Swedish origin.

The next chapter deals with the use of isotopes for the study of photosynthesis. The author has shown how the earlier ideas regarding formaldehyde as first product have now been modified. Undoubtedly there is room for more work in this field and Mr. Dick, although adding the caption 'Complete photosynthetic carbon cycle' to the illustration on p. 43, is wise enough to decide in the text that this cycle, worked out by chemists of the University of California, cannot be accepted as a completely established fact. Perhaps one of the more striking discoveries, and one which upset previous theories, is the ability of plants to take up carbon dioxide through their roots, a function which hitherto was considered to be the monopoly of

leaves. The absorption of other nutrient elements through leaves as well as the root system merely emphasises that we cannot take too rigidly the viewpoint that metabolic activities are restricted to certain organs.

The chapter on the use of radiations in the war against pests is fascinating and offers considerable hope for future improvement in pest control operations using chemicals, provided that we can keep pace with the rate at which Nature allows her creatures to acquire immunity to insecticides. The part played by tracer elements in forestry is considerable and the author's account of the work will give much inspiration.

The final chapter treats in a particularly interesting way the question of food preservation by the use of atomic radiations. Very well brought out here, and, indeed, too often neglected in many other books on the subject, is the possibility of inducing nuclear reactions with consequent danger from radioactivity, and perhaps also chemical changes which may affect the nutritive value and organoleptic* appeal. The distinction between satisfactory and complete sterilisation is made; this is important, since the latter may well require such large radiation doses as to cause serious damage to the product.

This book is very well written and can be heartily recommended, not merely to agriculturists, but also to a wider public, since there is in it so much information of value to biologists, geneticists, food specialists, research workers and others working in this field.

F. R. PAULSEN†

Ministry of Agriculture

The Approved List for 1957 has now been published under the Crop Protection Products Approval Scheme and provides a useful guide to many matters connected with the use of chemical products for the control of crop diseases, pests and of weeds.

Notes on each chemical include a full list of pests and diseases for the control and partial control of which it is recommended and any precautions which should be taken in using the chemical. Names and addresses of manufacturers of proprietary products are given and there is a comprehensive alphabetical index, including Latin names.

Copies may be obtained from the Ministry of Agriculture, Fisheries and Food (Publications), 23 Soho Square, London, W.1.

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The Locust

A new addition to the British Commonwealth Leaflets series deals with the battle of the locust. Tracing the acquisition of knowledge of this scourge—which, until 20 years ago, was very little—the booklet goes on to describe the gradual establishment of international co-operation in control measures and in the collection of information. The war against the desert locust, *Schistocerca gregaria*, is still the most difficult, since the pest ranges over such a vast area, some parts of which are almost inaccessible. Dealing with swarms each season as they arise is very costly and research is now being directed towards the possibility of preventing the actual formation of swarms. This is likely to be of long duration, but there is hope of ultimate success.

Published by H.M.S.O., price 6*d*.

*

Corrosion Convention Proceedings

All 13 papers read at the Corrosion Convention held by the Leonard Hill Group in London on 15 and 16 October will be published, together with the ensuing discussions, as a book entitled ' The Proceedings of the Corrosion Convention '. It is hoped that the book will be available early in 1958.

As it is anticipated that there will be a heavy demand, intending purchasers should send their orders without delay, together with a remittance for 21*s*., to the publishers, CORROSION TECHNOLOGY, Leonard Hill House, Eden Street, London, N.W.1.

Bookshop Service

All books reviewed in WORLD CROPS *and all other scientific or technical books may be obtained from:*

Technical Books,
308 Euston Road,
London, N.W.1
Telephone: Euston 5911

Prompt attention is given to all orders

Tobacco

Factors in the Production of Healthy Tobacco Seedlings is Bulletin No. 6 of the Tobacco Research Board of Rhodesia and Nyasaland. It contains papers on ' Selection of the Site '; ' Fertilisation, Seeding and Management '; ' Soil Treatment for Weed and Eelworm Control '; Insect Pests and their Control '; ' Disease Control '; and ' Turkish Tobacco Seedbeds '.

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Other Publications

We have received copies of the following publications:

Progress Reports from Experiment Stations: Surveys and Summaries of Reports for the season 1955–56 published by the Empire Cotton Growing Corporation, which also lists the individual reports for the season. These are available at 7*s*. 6*d*. for the set of 10, or at 9*d*. each.

Algas Macroscopicas dos Arrozais Portugueses (Macroscopic Algae in Portuguese Rice Fields), published by the Comissao Reguladora do Comercio de Arroz, Lisbon.

San Jose Scale (Aspidiotus perniciosus *Comst.*) in Europe and the Mediterranean Basin, 1956, published by the European and Mediterranean Plant Protection Organisation, 142 avenue des Champs Elysees, Paris, price 1*s*. or 50 F. fr. No important spread of the pest was recorded in 1956.

Green Bulletins Nos. 3 and 4, published by Verlagsgesellschaft für Ackerbau m.b.H., Sophienstrasse 1, Hannover, Germany. No. 3 *Science and Practice in the Manuring of Pineapples*, contains information about reaction to fertilisers in the different pineapple-growing countries, with special reference to potash. The title of No. 4, *The Supply of Nutrients to Cotton with special reference to Potash*, is self-explanatory.

Report on the Suitability for the Cultivation of Tea of Lands in the Bamenda Area, Southern Cameroons. Dr. T. Eden, the author, undertook a survey of the area at the invitation of the Production Development Board in order to estimate the possibilities of successful tea cultivation, and here presents his findings and recommendations.

Annual Report for 1956 *of the Tea Research Institute of East Africa.*

Annual Report of the Department of Agriculture, Jamaica, 1955.

* Organoleptic = relating to senses of taste and smell.—*Ed.*

† Editor of *Atomics*, a Leonard Hill publication.

MACHINERY AND EQUIPMENT

An Ingenious Knapsack Sprayer

An entirely new departure in knapsack sprayers has just been produced by the Kestrel Engineering Co. The new features are the unbreakable lightweight container and the patent extending lance.

The liquid container, which is of 2 gal. capacity, is made of translucent polythene, so that the amount of liquid can be seen at a glance. This container is quickly detachable for filling or washing out, or even for replacement by another container with a different spray liquid. The polythene container is so light that, when empty, the knapsack unit weighs only 9 lb. and, when full, only 29 lb.; polythene is so strong that the container can be dropped on concrete or kicked about without damage; it is resistant both to cold and to heat, being unaffected by temperatures up to 180°F; it is also unaffected by chemicals, with the exception of creosote, which causes some swelling.

The standard lance supplied is a tubular rod, 2 ft. long; a telescopic lance which can be extended to 12 ft. can also be supplied. Both are hollow brass rods which support the polythene tubing; thus the spray liquid does not come in contact with any metal, as there is polythene all the way from the container to the jet, and there are no glands to leak. This tubing does not split or crack and, if accidentally damaged, it can be very easily renewed or replaced.

Disinfecting with a 'Kestrel' knapsack sprayer with the short lance

The lever-operated pump can exert a pressure of up to 45 lb./sq. in.; it is of very simple design and requires no servicing other than the replacement of the diaphragm after a few years. There is an easily disconnected filter to hold back any matter which might choke the jet, and any type of jet can be fitted.

This machine would appear to be ideal for use overseas, as no servicing is necessary and no spares need be kept. Furthermore, by having a number of polythene containers, it will be possible to make up spray solutions under close supervision at, say, weekly intervals. This will obviate the danger of mistakes in the use of toxic chemicals and will also prevent pilferage of these valuable materials.

The telescopic lance can be used to spray up to 16 ft. above the ground. It is therefore suitable for spraying young palms at a time when they are most susceptible to attack by pests. The machine is also recommended for spraying cocoa, coffee, sisal, pineapples, tea, tobacco etc. The longer lance is particularly suitable for fumigating and spraying greenhouses, as it can reach into every corner, and for the same reason it can be used for the anti-malarial spraying of the gutters of bungalows, for killing flies hiding in the rafters of market buildings and for disinfecting infectious disease wards.

Reader Service

For further information on any item of machinery or equipment reviewed in this issue please write to:

Reader Service,
WORLD CROPS,
Leonard Hill House,
Eden Street, London N.W.1,
England

Tea Plucking Baskets

Baskets made from riveted aluminium, supplied by the Northern Aluminium Co. Ltd., are proving popular in East Africa. These baskets are 18 in. in diameter and 18 in. high and are made of flat aluminium bar. The covering, which may be made of sacking, canvas, hessian or other inexpensive material, is placed within this frame, as shown.

The frame of this tea plucking basket is aluminium, with a lining of canvas

The aluminium framework costs about 15*s.*, as against 3*s.* 6*d.* for the locally-made wicker basket, but, whereas the former lasts almost indefinitely, the latter has a 'life' of only three or four months. The canvas or hessian will, of course, require replacement from time to time.

Threshing and Cleaning Groundnuts

Unlike potatoes, which are lifted without the haulm, peanuts remain attached to the vines and roots. Ransomes' groundnut threshers have been designed for speedy and efficient detachment of the nuts. The nuts are also cleaned and delivered into sacks. Fitted with pneumatic tyres, the machines can move easily over the ground where the crop is grown, passing from stook to stook, and leaving sacks of cleaned nuts and heaps of refuse for collection and disposal.

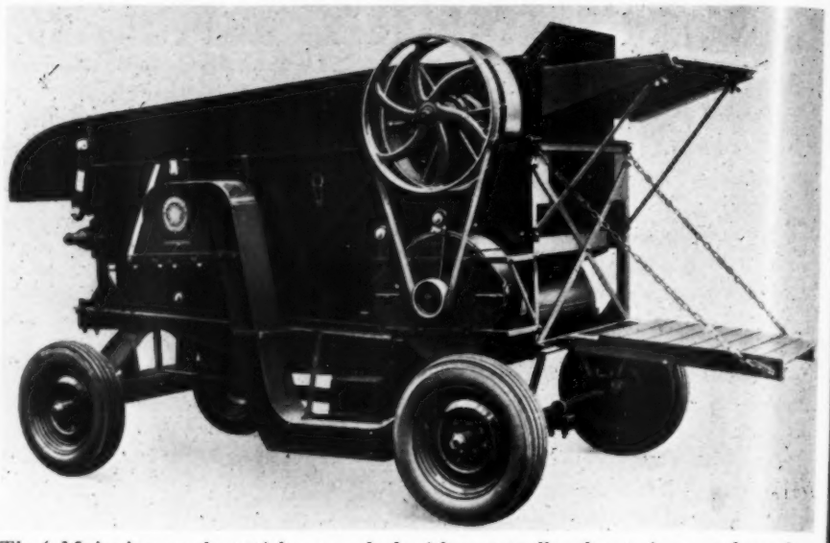
The machines are of simple design and do not require skilled labour to operate them. Two sizes are made: the 'Minor', which is capable of dealing with 8,000 lb., and the 'Major', with a capacity of 11,000 lb. of cleaned nuts in a 10-hour day.

The crop is fed into the machine down an inclined trough leading to the feeding table, and from there to the

drum by a man standing on an adjustable platform. The peg drum and concave* are of special design, combing the nuts from the roots and breaking up the larger clods of earth, all without puncturing or damaging the shells, thus making it possible for the nuts to be washed and bleached for export without ' blueing ' of the shell. The concave and four drum bars are supplied in different sizes for the small or large variety of nuts.

The remarkable cleanliness of the bagged nuts, of special value for crops produced on black land, is achieved by the operation of the re-cleaner and bagger. This consists of a fan and duct so arranged that the nuts are blown to a convenient bagging height, while the earth clods fall through an opening at the bottom of the duct.

* Concave : This is the concave metal grating surrounding the drum which pulls the nuts from the vine.

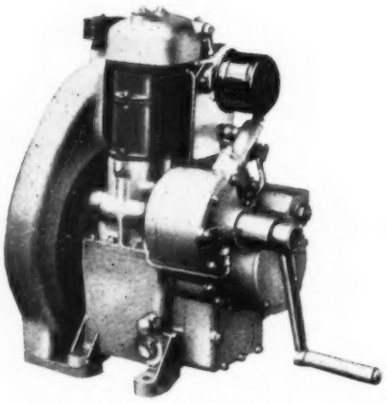


The ' Major ' groundnut picker can deal with 11,000 lb. of nuts in a 10-hour day

High Clearance Tractors for Sugar-cane

A high clearance version of the Farmall Super BMD tractor has been produced by Voltas Ltd., International Harvester distributors in India, to meet the special requirements of sugar-cane growing in India. This model has a cultivating clearance of 36 in. and is designed for use in Northern India, where the sugar-cane rows are normally spaced at 3 ft. The tractor can turn by pivoting on one wheel.

At a recent demonstration one of these tractors was fitted with a sprayer attachment for applying insecticides and fungicides during inter-cultivation; simultaneously six fertiliser boxes, also fitted on the tractor, were applying fertiliser to the sugar-cane, while six chisels were loosening the soil, and immediately behind these chisels were fitted the ' ridging bodies ' for earthing up. These four operations were carried out at the same time over cane which in some places had a height of 7 ft.



The Enfield ' 350 ' diesel engine, which has a high power/weight ratio

The ' Farmall ' super BMD tractor, as modified by Voltas Ltd., of Bombay, to meet the special requirements of sugar-cane growing in India

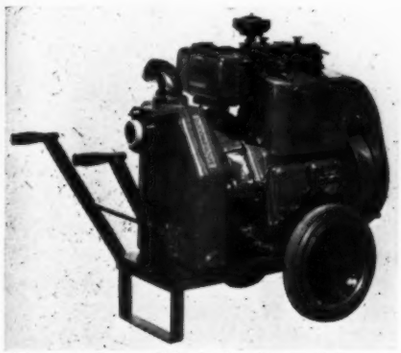
A New Power Unit

With the development of the Enfield ' 350 ' air-cooled high-speed power unit, a diesel engine assumes for the first time duties which have up to now been considered the prerogative of the petrol engine. The extensive use of aluminium in its construction and its ingenious layout have together produced an engine with a high power weight ratio, capable of robust performance throughout a speed range of from 500 to 3,000 r.p.m.

The power generated by this engine ranges from 2.1 b.h.p. at 1,000 r.p.m. to 4.5 b.h.p. at 3,000 r.p.m. The fuel consumption, even at high speeds, is exceptionally low, *e.g.* only 0.38 pint b.h.p./h. when running at 1,500 to 1,800 r.p.m. When working in a distant spot, there is no need for frequent supervision of the engine, nor for transporting large quantities of fuel oil. So far as overseas operation is concerned, it is stated that its performance is satisfactory at temperatures of up to 130°F.

This unit is recommended by the makers for use as a prime mover in the following applications: with electric

generators, air compressors and pumping sets; for operating shearing equipment, grass driers, milking machines, sawing machinery, high-pressure root-washing machines, baling machines, hoists, winches, elevators and conveyors; and as the prime mover in light tractors, road and grass rollers, mechanical cultivators, lawn mowers, hedge trimmers, together with a host of other applications in building construction and soil moving.



The model 105 HD ' Goodenough ' automatic, self-priming centrifugal pump is here attached to a diesel engine and mounted on wheels

A New High-head Pump

A new pump, described as model 105HD, has been added to the ' Goodenough ' range, primarily for use as a high-head pump for overhead irrigation. This pump will also be ideal for use in bridge and tunnel construction, for de-watering large sites where high heads are necessary, for emergency fire-fighting and for washing down farm vehicles and mechanical implements.

The pump is of the automatic self-priming centrifugal type; a special feature is its very quick repriming, even at suction lifts of up to 25 ft. Priming is achieved by the recirculation method and does not involve the use of valves, which are often a source of trouble. The pump will deliver 8,000 g.p.h. against a total head of 150 ft., or 12,000 g.p.h. against a total head of 100 ft.

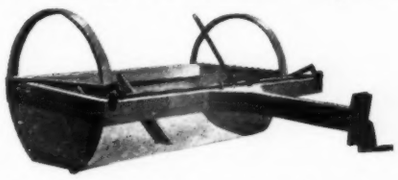
It has a 3-in. inlet and outlet and is made of non-corrosive aluminium alloy with a specially designed impeller in manganese bronze. The pump is direct-coupled to the engine and two versions are available—one with twin-cylinder air-cooled diesel engine, and the other with twin-cylinder air-cooled petrol engine. Both are portable and mounted on a two-wheel rubber-tyred trolley.

Rapid Moisture Determination

With the ' Universal ' moisture tester the moisture content of samples of granular materials, such as cereals, feeding cake, paddy, coffee or cocoa, can be determined in less than a minute. The moisture content can be read directly as a moisture percentage on the dial, without any need for calculations or reference to a chart. The machine is manufactured by Burrows Equipment Co., U.S.A.

For Paddy Fields

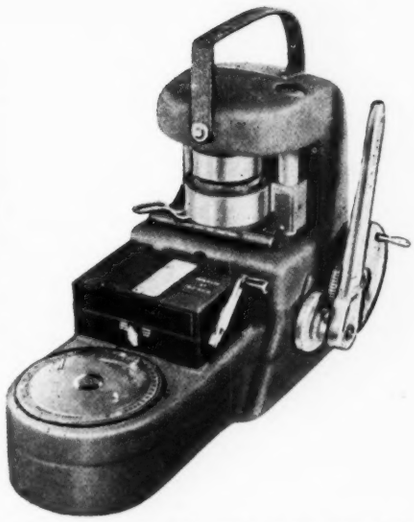
Originally used in the paddy fields of Uruguay as an animal-drawn implement, the Conder ' Earthworker ' is an up-to-date version of specially rugged construction to stand long use with heavy - wheeled tractors and medium crawlers. Described as a scraper-digger-dumper, its primary purpose is for soil-grading, *i.e.* for levelling and terracing the fields, and for building bunds. It can also be used for making silo pits, for levelling sites,



The ' Earthworker ', a trailed scraper, digger and dumper combined

for road-making, for spreading materials and for dumping them.

It is essentially a scraper bucket, which drops its accumulated load just where it is required, merely by releasing a light action latch, so that the bucket turns over. There is an adjustable hitch which varies the depth of cut and a locking device for non-spill carting.



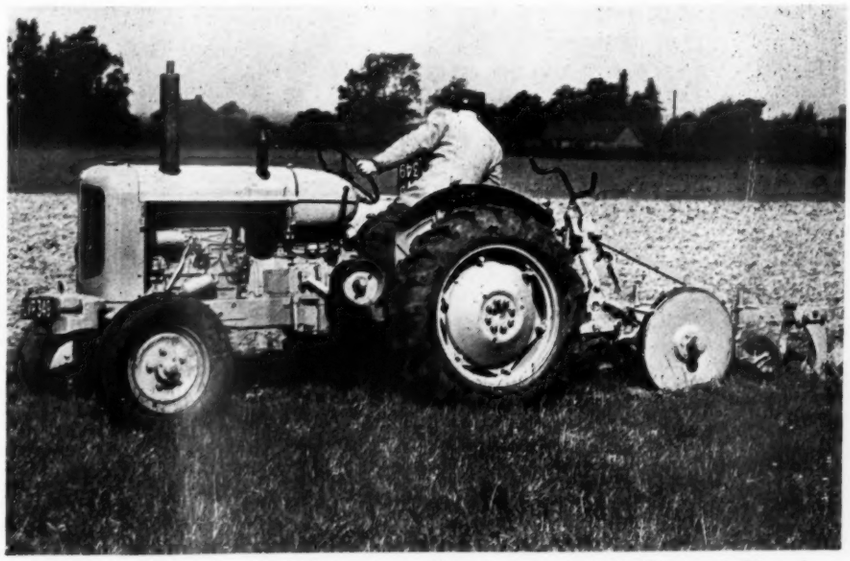
Moisture content of any granular material can be read on the dial in one simple operation

The implement is available in two standard sizes, one allowing a 4-ft. cut and with a bucket capacity of 16 cu. ft., and the other with a 5-ft. cut and a 22 cu. ft. bucket.

Smaller ' Universal Three '

The Nuffield Organisation is introducing a new and smaller tractor, which will be known as the ' Universal Three '. The current model will continue in production and will now be designated the ' Universal Four '.

The new tractor is similar in design with the same unit principle of con-



The new and smaller Nuffield tractor will be known as the ' Universal Three '

The Auster 'Agricola' has now been fitted with spraying equipment. This aircraft is already in use in New Zealand for fertilising hill land from the air

struction, thus facilitating easy maintenance.

The power unit is a new 3-cylinder B.M.C. diesel engine of 2,551 c.c. capacity derived from the B.M.C. 3.4-litre engine of the larger model and with the same characteristics of fuel economy. The engine develops 37 b.h.p. at 2,000 r.p.m. when installed in the tractor. The hydraulic lift linkage is designed to take either category one or category two implements and adjustment to either size is simply and speedily effected.

An important modification to the hydraulic power unit is the increase in the movement of the control lever, which gives the operator better control over the rate of lift. This will also make it easier—by increasing the time factor—to manipulate the control so as to give the required amount of transferred weight. It will now be possible for a driver after only a little practice to obtain weight transfer in almost any degree and so give traction otherwise obtainable only with wheel weights or by ballasting the rear tyres.

One of the useful features of this new tractor is the parts interchangeability between it and the Nuffield ' Four ', as many components will be common to both models.

Ground speeds are so arranged that a crawling speed of 0.5 m.p.h. is possible for precision planting etc., whilst the top speed of 14 m.p.h. will be useful for movement along roads.

A 12-gallon Power Sprayer

A new addition to the H. D. Hudson Mfg. Co.'s range of power sprayers is now on the market. This machine has a positive piston pump which discharges up to 2½ gal./min. at any pressure from 20 to 250 lb. The pump has spring-loaded valves with nylon seats and disks and is fitted with a pressure gauge. The tank is galvanised steel with a 5½-in. filler opening. Agitation is by jet overflow.

This compact unit moves on two cushion-tyred disk wheels and is equipped with 12½ ft. of spray hose and an adjustable power gun.

Reducing Tractor Wheelslip

A traction control unit for use with Fordson Major tractors is offered by Lawrence Edwards & Co. (Engineers) Ltd. This unit has been tested by the British National Institute of Agricultural Engineering in varying conditions and was found to give appreciable reduction of wheelslip in most conditions and so allow ploughing to be carried out at a greater depth than when using the depth wheel. It will thus be useful for heavy conditions where ordinarily continuous ploughing is not possible or where wheelslip is so bad as to cause much waste of time and fuel. In less adverse conditions where wheelslip is present, though not so noticeable, the use of this appliance will give more ploughing for the same number of wheel revolutions.

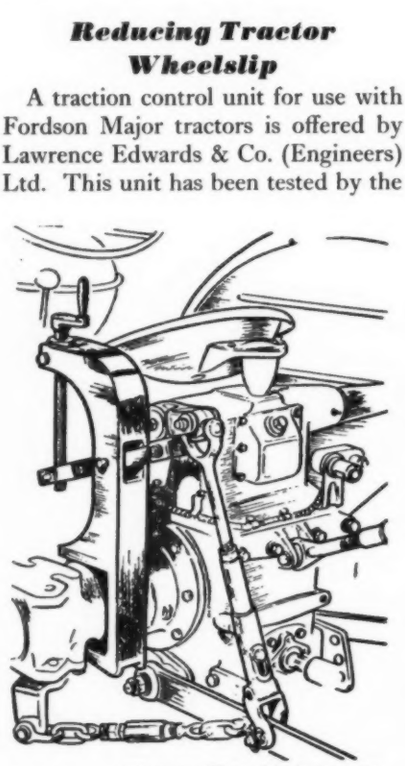


Diagram: 'Farm Mechanisation'

The Edwards' tractor control unit. The greater the pull from the plough, the greater is the downward force on the rear wheel of the tractor

The unit works by means of a pivoted lever, which acts as a stop to limit downward movement of the hydraulic lift arm and, in effect, the force required to pull the plough is transferred to a point over the rear axle of the tractor. Consequently, the greater the pull of the plough, the greater is the downward force applied to the rear wheel and, therefore, the greater the wheelgrip. The unit can be adjusted from the tractor seat by means of a screw handle; it is strong in construction and simple to fit and operate.

Aerial Spraying

The Auster ' Agricola ', an aeroplane specially designed for agricultural operations (see WORLD CROPS, 1957, **9**, 83), has now been fitted with built-in spraying equipment. To cut down drag, the spray booms are mounted inside the wings, so that only the spray nozzles protrude below the trailing edge. Heavy rates of application are now possible—up to 40 gal. per acre can be applied in a single operation.

Agricultural Chemicals

Ammonium nitrate as a blasting agent: weedkillers & insecticides: a nematocide: a fungicide: & a foliar nutrient

Plant Destruction

'Weedicide 100' is a concentrated liquid arsenical weedkiller which destroys all vegetation with which it comes into contact. It is specially suitable for the destruction of weeds and moss on paths, roads, railway tracks, hard tennis courts, and for clearing bush and standing timber.

It has a special use in agriculture in temperate regions for the destruction of potato haulms and in the tropics for the suppression of lallang, illuk or cogon grass, *Imperata cylindrica*.

*

Sea Magic

The new technique of feeding crops through their leaves is a comparatively recent discovery and came about almost accidentally. A spray derived from seaweed was first tried on hops by one of the large brewery companies, and it proved so successful that experiments were made on all kinds of crops—from wheat to lettuce and apples to strawberries.

'Sea Magic' is a dark-brown, viscous fluid paste, consisting of 80% liquefied seaweed, carefully blended from a dozen different varieties including the important *laminaria*. The remaining 20% is derived from the tissues of a number of land-plants which have properties similar, but complementary to seaweed. No inorganic chemicals are added.

Its plant hormone content, ensures a strong and vigorous root system and will inevitably produce grass which lasts longer and will be far better able to survive conditions of drought. It also encourages a good 'take' of broad-leaved herbs and clover which, in turn, provides free nitrogen for the rest of the sward.

The first noticeable effect is on the leaves themselves. They take on a darker and healthier colour with a pronounced sheen, and new shoots are ample and vigorous. There is also a marked increase in resistance to disease.

It is the ideal foliar nutrient because it contains the trace elements needed for healthy growth, it is entirely organic, easily assimilated and cannot hurt bud, blossom, fruit or foliage—even if applied neat, and it is chemically inert, alkaline and may be sprayed either alone or mixed with any other material during a routine spraying.

'Sea Magic' is recommended by the makers for such varied crops as apples, hops, potatoes, tomatoes, soft fruits, cereals, legumes and grass—both lawn and pasture.

*

For Crop Pests

Eston 'Alkron' is manufactured to exact standards and five formulations are available to fit the many requirements of spray equipment, safety in handling, superior insect control and economical usage.

'Alkron - 25E' is recommended wherever the use of parathion as an insecticide is accepted, particularly for application by aeroplanes or low-volume ground sprayers, where wettable powders may not be satisfactory. It contains 2 lb. of parathion per gal. in an aromatic solvent base. When mixed with water, emulsification is rapid and complete and the resulting spray solution will wet the most difficult surfaces.

For specific uses, where a minimum of solvent and a high active ingredient content are necessary, 'Alkron-4E' is recommended at one-half the dosage of 'Alkron-25E'. 'Alkron-4E' contains 4 lb. of parathion per gal. in an aromatic solvent with emulsifier. It is particularly useful in concentrate spraying and in atomised fog generators, such as the 'Hi-Fog'.

Eston's latest contribution to safety in the handling of parathion formulations is 'Alkron-50E', in which 50% by weight of parathion is dissolved in an oil-soluble emulsifier carrier to inhibit the skin absorption characteristics of parathion. Though less hazardous than other liquid concentrates of parathion, it should be handled with the precautions accorded to parathion in any form. 'Alkron-50E' has proved very useful in control of aphids and leaf-hoppers on various vegetable crops where low-volume spraying is practised and little or no tank agitation is possible.

'Alkron' formulations are used for the suppression and control of red scale, yellow scale, purple scale, citricola scale, cottony cushion scale, citrus thrips, leaf-rollers, tortrix, aphids on citrus; olive scale and other scale insects on olive trees; aphids, spider-mites, scale insects on walnut trees; aphids, scale crawlers, shothole borer, spider-mites on apple, pear and plum trees; cherry fruit fly, scale crawlers, shothole borer, spider-mites on cherry trees; mealybugs on pineapple leaves; greenbugs (aphids) on wheat; aphids, mites on hops; aphids on peas and carrots and aphids, mites on cotton.

*

For Soil Fumigation

With the increasing importance now being attached to the control of plant parasitic nematodes, or eelworms, the introduction of a new nematocide is of particular interest.

At present the nematocides most widely used for field and glasshouse soil fumigation are D-D (1,3-dichloropropene-1,2-dichloropropane mixture) and ethylene dibromide; both give good control of many nematodes, but they are phytotoxic and therefore have to be injected—using special equipment—some time before a crop is planted.

Shell have now introduced 1,2-dibromo-3-chloropropane, under the trade name 'Nemagon', as a soil fumigant, which is not only entirely harmless to a considerable number of crop plants, but which can be formulated for application in granular or emulsion form to the soil surface without the use of special equipment. In addition, 'Nemagon' has the advantage of giving effective nematode control at comparatively low dosage rates (usually less than 10 gal. per acre).

'Nemagon' promises extremely well for the control of nematodes attacking a number of tree and other perennial crops, and work in the U.S.A. and elsewhere has indicated that established plants to which it is not phytotoxic include apricot, asparagus, banana, cherry, citrus, coffee, fig, grape, hibiscus, peach, pineapple, plum, rose, strawberry, sugar-beet, tea and walnut.

As a pre-plant treatment it is satisfactory for a number of other crops,

including bean, cantaloupe, carrot, clover, cotton, cucumber, parsnip, pea, peanut, pepper, radish and squash.

Certain crops are, however, sensitive to ' Nemagon '. For this reason it cannot be recommended for onion or tobacco (either as transplants or as a pre-plant treatment), for sweet potato transplants, nor for pre-plant treatment of Irish potato, garlic, garden beet and sugar-beet.

*

Strawberry Rot

Every year a percentage of the strawberry crop is lost unnecessarily to Botrytis fruit rot, and in wet years this loss can be extremely serious to the grower. Picking is made more costly and slightly infected fruit may soon break down after picking and spread the infection to sound fruits.

Botrytis losses can be prevented by dusting with ' Orthocide Dust 15% Captan, produced by the Murphy Chemical Co. Ltd. This is a new formulation which is used at 20 to 25 lb. per acre and this gives a sufficient amount of captan without an objectionable deposit on the berries. Following this treatment, strawberries will travel better and keep longer, and thus command higher prices. ' Orthocide ' must not be used on strawberries for canning, but it may be used safely if the crop is for jam-making or deep freezing.

*

Organo-Phosphorus Insecticide

Malathion is an organo-phosphorus insecticide of high toxicity to a wide range of insects, but low in toxicity to man and animals.

Technical malathion is a deep brown to yellow liquid, only very slightly soluble in water, but miscible with many organic solvents. This is presented by Universal Crop Protection Ltd. in various formulations.

Malathion is of special value for the control of aphids, mites, mealy bugs and scales, but also for thrips, psyllas, leafhoppers, certain beetles, cabbage worms and loopers, etc. in various field and fruit crops. It can be recommended in most cases where parathion was formerly used and where it is desired to avoid the hazards associated with parathion application. Malathion does not share the high degree of mammalian toxicity associated with the other organo-phosphorus insecticides and is 100 times less toxic than parathion.

Residues on plants are lost very rapidly after application, and on most crops, the allowance of an interval of ten days between the last application and harvest, results in a residue of less than 1 p.p.m., which is below announced official tolerances.

*

MCPA

' Agroxone ' 4 is a liquid hormone weedkiller based on the potassium salt of MCPA. It will suppress or check many broad-leaved weeds and sedges in cereals, including wheat, oats, rye, barley, rice, maize and sorghum, also in linseed (for seed and fibre), sugar-cane and groundnuts, and on grassland and cultivated turf.

This weedkiller can be applied through any form of high- or low-volume spraying machine that ensures even coverage. All that is necessary is to dilute the recommended quantity with an amount of water according to the rate of delivery of the sprayer. With high-volume sprayers 100 gal. of spray fluid per acre (1,000 l./ha) is the normal rate to apply and with low-volume machines 10 gal. per acre (100 l./ha.).

' Agroxone ' 4 is normally applied post-emergence, although on certain crops, *e.g.* maize and sugar-cane, it can also be applied pre-emergence. Weeds must be in a state of active growth; in general, it is applied early to suppress annual weeds, later for perennial weeds, but within the period specified for the crop.

*

For Blasting

Use of ammonium nitrate fertiliser as a blasting agent is well beyond the field test stage. This comparatively new method of blasting has three factors which contribute to its growing popularity: it is extremely safe, it can be controlled and it is cheaper than the usual blasting agents.

Ammonium nitrate fertiliser remains fertiliser until it is poured into blasting holes on the job. There three conditions must prevail before it becomes an explosive: it must be mixed with the correct amount of fuel oil, it must be confined, and it must be detonated by a charge of dynamite.

Experience has taught powder men how to control the blast to attain almost any desired result and they can control ammonium nitrate fertiliser just as easily as they can other blasting agents.

Monsanto, of U.S.A., a large supplier of ammonium nitrate fertiliser to the fertiliser manufacturing industry, have been studying this new application for some time under various conditions and have developed procedures for obtaining optimum results.

In addition to being used in surface mines and quarries, ammonium nitrate fertiliser is now being used for general blasting operations in many countries. It has been used successfully in earth, sandstone, shale, slate, chalk, limestone, basalt and granite. It would appear, therefore, to be a suitable explosive for blasting planting holes in a rocky terrain and for the removal of the very large stumps of jungle and forest trees.

*

A New Petroleum Unit

Plans to erect a plant at Fawley, near Southampton, England, for the manufacture of ethylene oxide derivatives have been announced. Its production will contribute to the expanding activities of Union Carbide Ltd., a British affiliate of the Union Carbide Corporation of the U.S.A. The plant is scheduled to be working in 1959 with an annual production of 45 million lb. In the new plant ethylene will be converted into a number of ethylene oxide derivatives, and there will be installations for the production of ethylene oxide, ethylene glycols, polyethylene glycols, ethanolamines, glycol-ethers, and specialised products, including polyglycol ethers, polyglycol esters, and other surface-active agents.

The agricultural applications and uses of the chemicals to be manufactured include: anti-freeze for tractors, brake fluid formulations and ingredients for synthetic fibres, detergents for cleaning machines and agricultural equipment and also dairies and milk utensils, and agricultural chemicals and solvents for paints.

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Leonard Hill House,
Eden Street, London N.W.1,
England

WORLD CROP REPORTS

Analysis of the present wheat situation

INTERNATIONAL REPORT

Wheat and rye

Total wheat production in *North America* this year was 82% of the production last year. The sharp reduction in Canada was caused mainly by extremely dry weather during the growing season over wide areas of the Prairie Provinces, especially in Saskatchewan and Alberta. Damage from hail was heavy in parts of the west and excessive moisture caused considerable losses in parts of Manitoba. Wheat yields for the country as a whole averaged only 17.1 bushels per acre, compared with the high yields of 25.2 bushels last year. The preliminary forecast of 360 million bushels was based on conditions as at 15 August, assuming favourable weather conditions for the remainder of the growing and harvesting season.

Production in the U.S.A., estimated at 923 million bushels, was harvested from the smallest acreage in more than 50 years. High yields brought production within 7% of the 1956 harvest. The estimated yields of 21.4 bushels per acre are the highest on record. The crop is made up of 690 million bushels of winter wheat and 233 of all spring.

Rye production in North America is slightly above the 1956 crop because of an increase in the U.S.A.

Wheat production in *Europe* is the largest on record, on the basis of preliminary estimates. The total for Western Europe is about 1.43 billion bushels, compared with 1.21 billion last year. An acreage increase of about 11% and higher yields for the area as a whole account for the large out-turn. Record harvests were reported for a number of countries, but the largest increase from the 1956 crop is in France, where the estimated 1957 crop of 385 million bushels is 60% above the very small harvest in that country last year.

Production is also larger in the Danube Basin and Central European countries. An increase of about 10% over the poor 1956 crop is the result of higher yields, with acreage estimated to be a little below the 1956 acreage.

This is an important area for rye and the 1957 production is estimated at 430 million bushels, about 5% above the 1956 total. Rye production in Western Europe is estimated at 280 million bushels—little change from the 1956 total.

Another large wheat acreage increase was reported for the *Soviet Union*. However, drought over large parts of southern and eastern regions, including a considerable part of the so-called new lands, had a detrimental effect on yields. It now appears that overall wheat production will be below the record level of 1956 despite the acreage expansion. Weather conditions were more favourable in the principal rye-producing regions and rye production may be about the same as in 1956.

Wheat production in *Asia* is tentatively estimated to be larger than in 1956. Record yields resulted in record harvests for a number of countries of the Near East, including Iran, Iraq and Syria. Near-record crops were reported for India and Pakistan mainly because of increased acreage. Production in Turkey turned out much better than early season forecasts and the wheat crop is now estimated somewhat above the 1956 outturn and also well above average.

Rye production was also up in Turkey, with both acreage and yields above the 1956 figures. Turkey is the only rye-producing country of any importance in the area.

In *Africa* the wheat crop was smaller than in 1956. Considerably smaller crops are reported for Algeria and Morocco and those reductions account for the bulk of the decline. Production in Egypt is about the same as in 1956. Rye is of no significance in the area.

It is early in the season for reliable information on prospects for the southern hemisphere. Preliminary reports on the crop recently sown in *South America* indicate generally good conditions. In Argentina, the principal producer of the area, the condition is described as good to excellent. The first official estimate places acreage at 10% below the 1956 acreage.

No information is yet available on the rye acreage; a large part is normally used as pasture and approximately only one-third of the acreage sown is developed for grain.

Conditions in *Australia* have been unfavourable for the wheat crop and the out-turn may be almost as small as the poor crop harvested last year. Widespread drought during the normal sowing period and part of the growing season interfered with sowing and development of the crop. Rye is of little importance in Australia.

REGIONAL REPORTS

U.S.S.R.

Recent Soviet crop estimates indicate that the plan to increase substantially the sale of meat, butter and milk in the U.S.S.R. will be helped by adequate fodder supplies this season.

Prospects seem particularly good for *maize*. Considerable quantities are now grown in the Ukraine which—following last year's big *wheat* harvest from the virgin lands, in the east—is being transformed into the major dairy farming and sugar region.

In the east, however, the prospect of another record grain output has been threatened by early drought and cold weather.

Poland

Figures recently published in the Warsaw press (*Zycie Warszawy*) indicate that this year's harvest of basic food crops has exceeded all previous post-war yields.

So far as the cereal crops (*wheat*, *rye*, *oats* and *barley*) are concerned, it is estimated that the average yield for the whole of Polish agriculture (*i.e.* State, co-operative and private farms) is 14.7 quintals per ha., *i.e.* about 1 quintal per ha. more than last year. Co-operative farms registered the greatest increase with an average of 16.8 quintals of grain per ha.

The yield of *potatoes* has been less than last year, but the *sugar-beet* harvest has shown a marked improvement, averaging about 207 quintals per ha. or 20 quintals more to the hectare than last year. In this connection the Minister of the Food Industry has recently stated that this year Poland will produce a million tons of sugar, by comparison with 760,000 tons last year. This should cover domestic needs and leave some for export.

British West Indies

The following particulars of 1955 and 1956 *sugar* production and estimated production in 1957, with local consumption in 1956 and estimated local consumption in 1957, for the sugar-producing territories which are members of the British West Indies Sugar Association, summarise the latest information received by the West India Committee:

Crop Results and Forecasts
(Long tons of sugar)

	Production			*Local and neighbouring consumption*	
	1955	1956	*Estimate,* 1957	1956	*Estimate,* 1957
Antigua	19,725	28,478	31,670†	1,589	1,316
Barbados*	171,010	151,171	204,525	12,232	10,500
British Guiana ..	250,111	263,333	285,000	17,919	18,000
Jamaica	396,551	362,390	359,786	52,925	60,000
St. Kitts	49,356	49,850	44,794†	4,924	4,564
St. Lucia	10,617	10,874	9,314†	1,693	1,920
Trinidad	192,793	160,230	167,805†	24,138	25,970
	1,090,163	1,026,326	1,102,894	115,420	122,270
St. Vincent ..	4,356	3,938	3,557†	2,632	2,500

* Production and export figures include fancy molasses at 290 wine gal/ton. of sugar.

† Final estimate.

Malaya

Production of *palm oil* during the first six months of 1957 is estimated at 29,450 short tons, a slight increase from the same period in 1956. Trade sources expect that palm oil production in the last half of 1957 will be 5–10% higher than in the first half.

Palm kernel production in the first six months of 1957, estimated at 7,300 tons, declined slightly from the comparable period in 1956.

Iraq and Iran

Smaller *date* crops than last year are forecast for both Iraq and Iran. This would be the second successive short date crop in Iraq, while in Iran, 1957 is the ' off-year ' in a pattern of alternating large and small date harvests.

Forecast production is also well below average in both countries.

The quality of new-crop Iraqi dates is reported to be excellent.

Hungary

A record yield of *paprika*—amounting to about 30,000 tons—is expected this year. This will produce more paprika spice than in 1951, the previous best year.

Sudan

Sudan's 1956–57 cotton production of 617,000 bales (500 lb. each) from an area of 764,000 acres represents its largest cotton crop in history. The final cotton progress report of the Ministry of Agriculture confirms earlier unofficial estimates of a new record crop both in total production and yield per acre.

The 1956–57 crop represents a 40% increase over production of 441,000 bales in 1955–56 and a 28% increase over the 1955–56 area of 598,000 acres. Yields ranged as high as 686 lb. per acre for Sakel-type cotton in the Gezira area, but varied sharply in other areas. The average yield for all areas was 388 lb., compared with 354 lb. in 1955–56.

	1950–54 *average*	1955	1956	*Forecast,* 1957
	Short tons	*Short tons*	*Short tons*	*Short tons*
Iraq	392,000	420,000	280,000	250,000
Iran	147,000	110,000	145,000	115,000

England and Wales

Although frequent rain hindered operations, the harvesting of cereal crops was almost completed in most areas. Yields per acre as at 1 October are expected to be a little above the average of the previous five years for wheat, slightly below average for barley and well below average for oats. The yield per acre of main crop and second early potatoes is expected to be below average; blight does not appear to have seriously affected tubers. Virus yellows are frequently reported among sugar-beet and mangolds; yields per acre of these crops are expected to be below average. Satisfactory progress was made with autumn cultivations.

Cereals.—In most areas frequent rain during the month hindered the completion of the harvesting of cereal crops. Yields now forecast for wheat, barley, oats, mixed corn and rye (in cwt. per acre) have dropped since the forecast published last month by 0.3, 0.4, 0.8, 0.4 and 0.3 respectively.

Root crops.—The lifting of second early and maincrop potatoes began in many areas. Blight was widespread on the haulm, which in most areas is now dead or burnt off. Reports indicate that lifted tubers are very little affected. The yield of second early and main crop potatoes is expected to be 7.8 tons per acre, as compared with a five-year average of 8.6 tons and a yield of 8.8 tons in 1956.

Seed crops.—Conditions for harvesting crops grown specifically for seed were mostly unfavourable and it is expected that yields generally will be below average.

Pastures.—Leys sown in the spring (including ' seeds ') made good growth on the whole, but there are some poor takes and patchiness owing to the dry conditions earlier in the year; some damage due to lodging of the cover crop is also reported. Leys sown in late summer and autumn have germinated well and made vigorous growth, but are more weedy than usual. Older leys made abundant growth. Permanent pastures have grown strongly and provided plenty of keep.

Acknowledgment is made to *For. Crops & Mark*, and to Barclays Bank, D.C.O., *Overseas Review* for much of the information contained in the above reports.

The item on England and Wales is abstracted from the monthly report of the Ministry of Agriculture, Fisheries and Food on agricultural conditions as at October.

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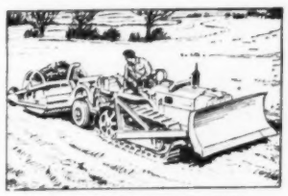

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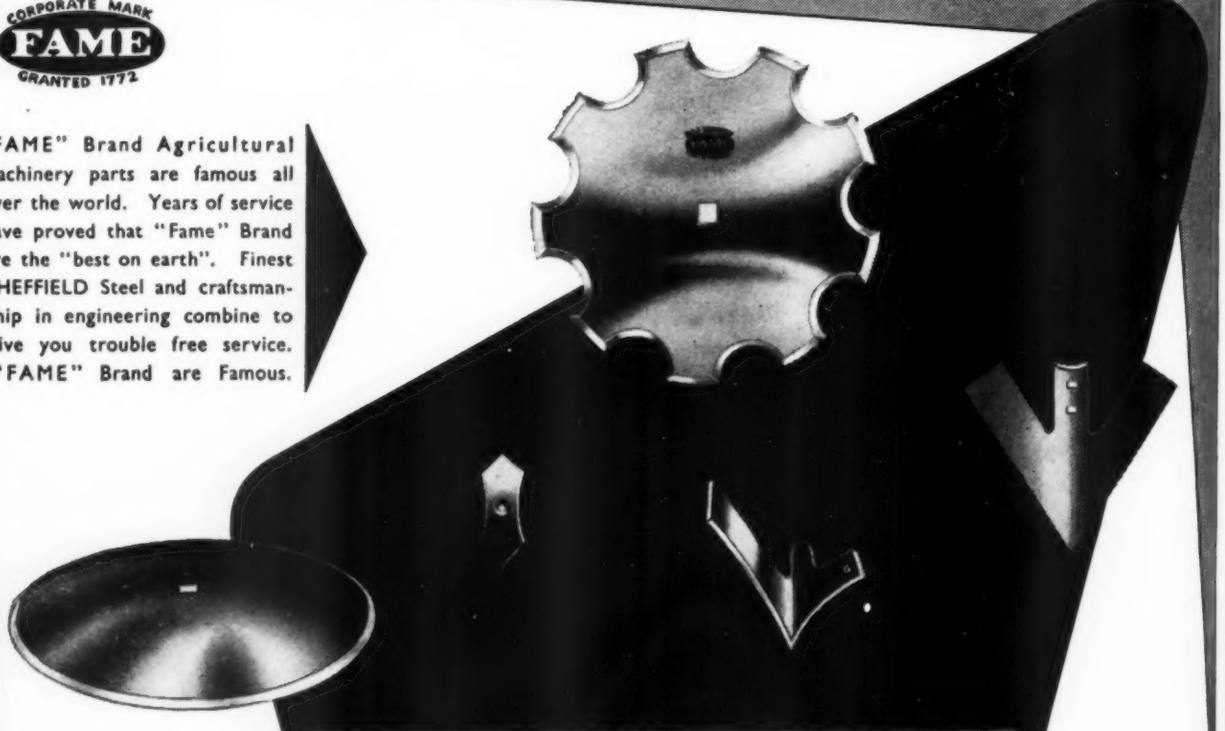

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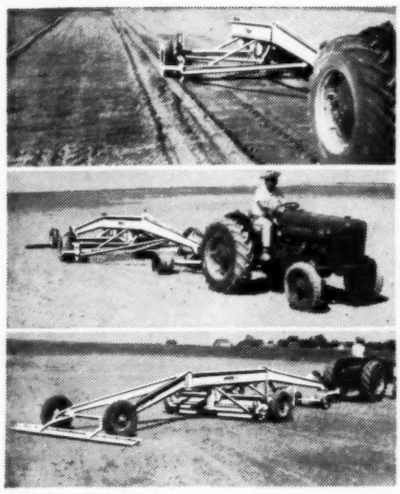

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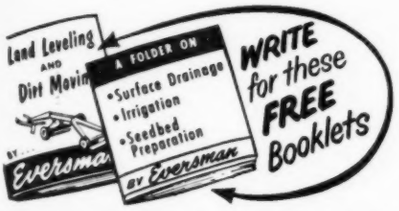

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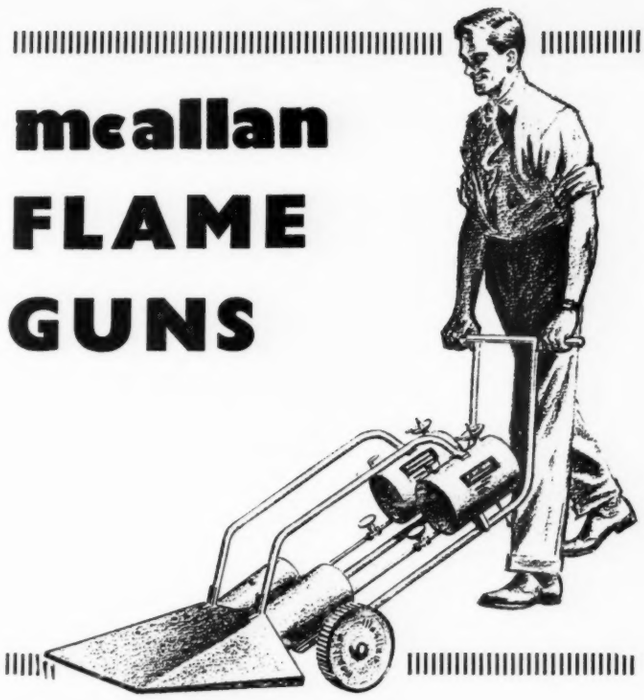

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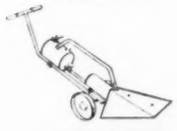

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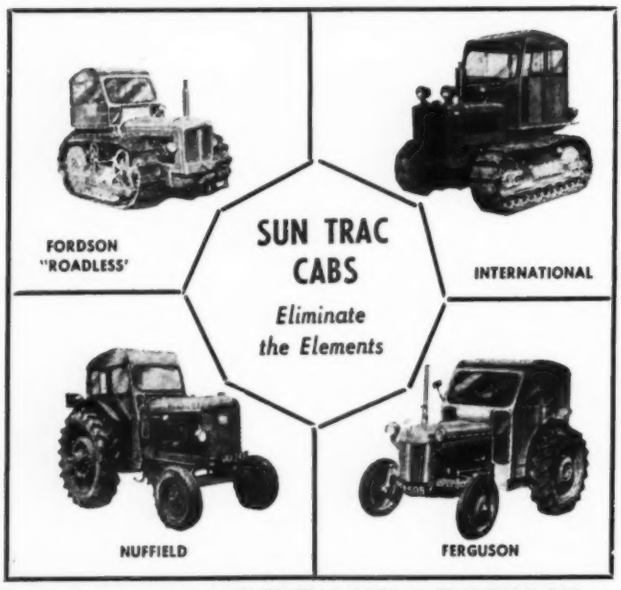

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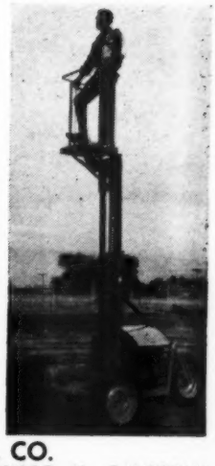

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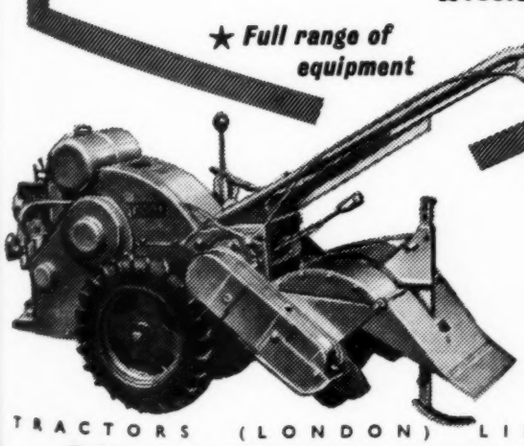

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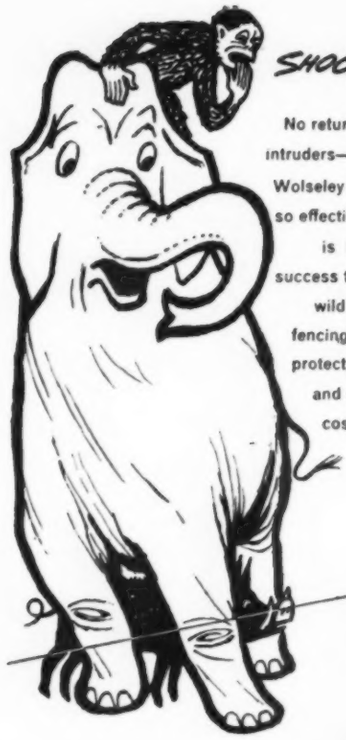

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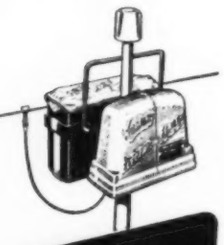

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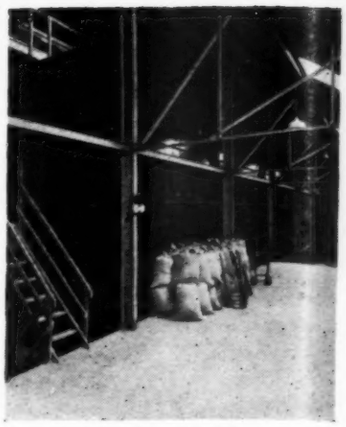

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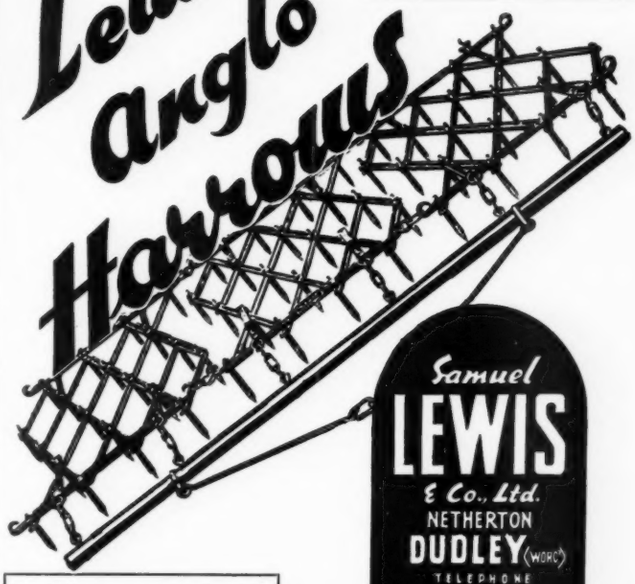

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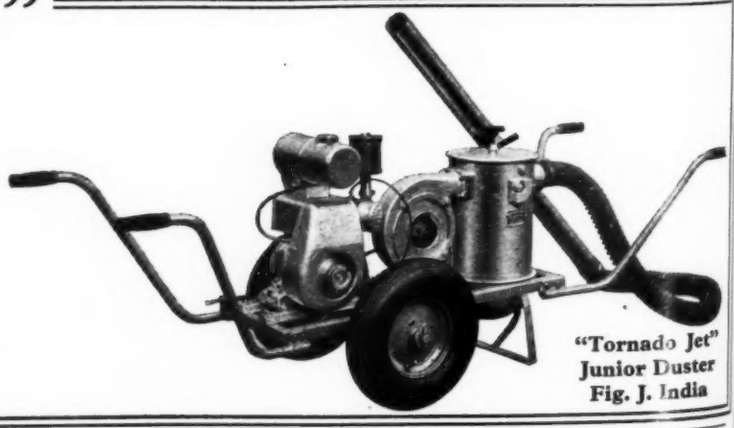

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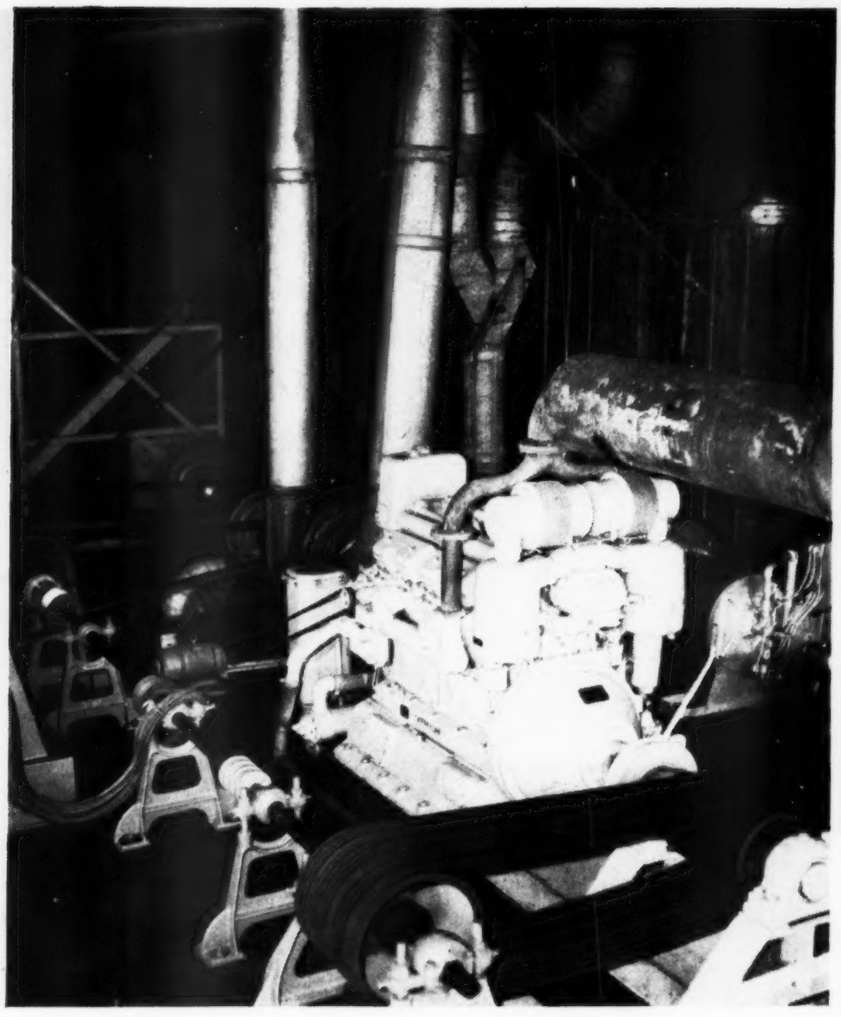

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